THE ART AND SCIENCE OF NUTRITION

A Textbook on the Theory and Application of Nutrition

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To

JOHN R. MURLIN, Ph.D.

whose research and teaching has
added much to the advancement of
nutrition as an Art and a Science

PREFACE TO THIRD EDITION

This book is designed to cover briefly the fundamentals of nutrition It, therefore, includes several chapters which perhaps are not regularly included in books on dietetics but which must be included under the broader term nutrition Such chapters include digestion, the blood, the endocrines, and some appendix material For those whose time or interest is limited, they may be omitted For those who have more time or added interest, they are again included in the third edition It is difficult to adapt data to all time factors and scholastic levels It seems more reasonable to be overinclusive and permit selection than underinclusive and require supplementation, from the viewpoint of both the instructor and the student

Increasing interest and importance is being attached to food in its relation to health, and educational methods whereby this information is disseminated That our educational program is effective is indicated by data presented by Dr Sherman in *Nutrition Reviews* Between 1915 and 1945 our national yearly per capita consumption of milk increased 52 per cent, of green and yellow vegetables, 79 per cent, and of citrus fruits and tomatoes 133 per cent As he puts it, we are "making people want the benefits which come from better food habits" We are moving toward the threefold goal set by the National Nutrition Conference of 1941—eradication of nutritional deficiency, reduction of infectious diseases, and "such levels of nutritional status for all as to ensure to each the degree of *health plus* that is potential in his hereditary birthright" Public opinion is making encouraging demands on producers and purveyors of food and educational and governmental agencies toward these ends

In preparing this third edition, the authors have incorporated the suggestions of reviewers in so far as they were practical and nonconflicting with comments of others The authors are grateful for constructive criticism and suggestions Only through them can the book become more widely adaptable And they are gratified by the kindly and encouraging support which the two previous editions have received

ESTELLE E HAWLEY
GRACE CARDEN

PREFACE TO SECOND EDITION

Nutrition as a science is playing an increasingly important part in the world of today and will continue to do so in the world of tomorrow. Its value has been established as a weapon of war and as an instrument of peace. Its importance is not only a personal matter; it is national and international.

A friend expressed this widened scope when he wrote: "Food is exciting to me. I like to eat. I like to cook. And when to that is added the gargantuan opportunity to build a nation—a nation with greater health, greater desire for living, greater satisfaction from living, longer life, greater accomplishments from living—an opportunity to make a contribution to the whole scheme of things which nutrition can make—then it is exciting—and no end." The needs of the individual, however, must be studied in order to set the pattern for the nutrition of nations.

The material for this new edition has been brought up to date with the advances in nutrition research of the past two years. The newer knowledge of vitamins, the dietary standards recommended by the Committee on Foods and Nutrition of the National Research Council, and additional adjustments of the normal diet for abnormal conditions are included. Recent pertinent references have been added to the bibliography.

The outline for teaching diet therapy has been entirely revised, and in order that the student may more readily follow the changes necessary, the tables dealing with diet adjustment relate directly back to the table showing the normal diet for the normal adult. Lists of supplies for the class work have been added to the laboratory outlines.

In the hope that it may help to stimulate the reader to the most serious consideration of good nutrition as a basis for good health, the authors present this second edition of The Art and Science of Nutrition.

ESTELLE E. HAWLEY
GRACE CARDEN

PREFACE TO FIRST EDITION

Recognition of the role which nutrition plays in clinical medicine is in no small measure due to Dr. James S. McLester's keen appreciation of the value of nutrition both in the prevention and in the

curative treatment of disease He visualizes a sturdier, happie[r] more vigorous race, whose economic and cultural attainment wi[ll] be greater and whose life span will be longer as the result o[f] intelligent application of the newer knowledge of nutrition with which science has endowed us

No longer is nutrition a mere matter of meal planning, based upon the meager knowledge or ability of the housewife It is now a matter worthy of careful consideration and study by the medical profession and its ally, the nurse, in whose hands it often lies and upon whose intelligent cooperation so much depends The nurse today must be trained to assume the detailed planning of diets and to know why and what adaptations are necessary in various disease conditions The busy doctor seldom has time to do more than indicate the dietary treatment, he may even omit a request for diet adjustment The nurse must, therefore, be able to prepare attractive, palatable, and nutritious meals which will tempt the appetite of her patient and at the same time take cognizance of the patient's metabolic dysfunction or need Recovery from any condition of disease hinges in a large measure upon the nutritional status of the patient One cannot hope to rebuild or sustain normal body tissue without adequate building material

It is with realization of the paramount need for scientific knowledge of food and its uses, and of disease and its metabolic consequences, that we have here outlined the principles of normal nutrition and have indicated when, why, and how modification of the normal diet may be necessary Space limitation prevents detailed discussion but it is hoped that with the fundamentals of nutrition and diet adjustment as given here, and the reference material suggested, the nurse may acquire sufficient knowledge of nutrition as an art and as a science, to enable her to play her role in the betterment of human life

ESTELLE E HAWLEY
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THE ART AND SCIENCE OF NUTRITION

THE ART AND SCIENCE OF NUTRITION

PART I
THE NUTRIENTS

CHAPTER I
NUTRITION AND ITS PLACE IN THE EVERYDAY WORLD

From the beginning of time, man has been interested in food and its relationship to himself The professional person—chemist, physiologist physician, nurse, nutritionist, or health educator—is concerned with the role food plays in the science of nutrition Most people, however, have a different concept of food If one were to ask a group of individuals "why do you eat?" a variety of reasons would be forthcoming These may be expressed as food tastes good," habit, eat at certain times," "for sociability " 'to keep alive " or "to grow " It is significant that many reasons are often given prior to the one that is the major concern of all who are interested in the physical welfare of others—' for health "

Recently, attention has been directed to the meanings that food might have for the individual Apart from the metabolic needs for food (with which this book is primarily concerned), the nonmetabolic uses of food have been explored Bayles and Ebaugh have expressed these as 'needs of a person as well as needs of a body " These nonmetabolic uses of food often reflect such needs as social, socioeconomic, or emotional satisfaction Eppright, in a paper titled Factors Influencing Food Acceptance," stated "It has been said that food with man is not just food, it is the crossroads of emotion, religion, tradition, and habit "

Babcock pointed out that an infant found his first satisfaction in eating, his first displeasure in being hungry, and his first human relationship is with the person who feeds him Food has been interrelated with the emotional and intellectual development of the individual throughout life Some emotional uses of food which have been suggested are to relieve anxiety, to com

pensate for rejection, to reward one's self and others, or to be used negatively and deny one's needs The use of familiar food to relieve tension from sources other than metabolic is an observable but unexplainable fact Bruch has described the obese child who has found release in food from the tension of being unloved To a dissatisfied homemaker, eating may mean diversion and thereby a respite from monotony An adolescent may turn to food *to compensate for social rejection Some foods, such as* steak or special desserts, often serve as a reward for work well done by one's self or others Many feel that it is "spartan" or that it develops character to deny one's needs, and food is often used in this way

Food frequently expresses interpersonal reactions It is easy to communicate pleasure or anger by the type of food that is served Many hostesses feel rejected if food is not eaten and praised Moore suggests that indifference or resentment is often expressed by not eating what is served or by overlooking the special efforts made Food many times symbolizes deep meanings of friendliness and affection and the invitation to eat may mean social acceptance Neighborly gifts often take the form of food

To many people, food is an expression of socioeconomic status Ethnic and religious customs are frequently reflected in food Fish on Friday, turkey for Thanksgiving, and a birthday cake are outstanding examples An abundance of food is often a mark of success to a man who has known poverty and deprivation Moore pointed out that foods themselves become "hoity toity" when they meet one or more of these criteria rare, expensive, difficult to prepare or infrequently liked, extreme in flavor or taste The homemaker's skill and knowledge are earmarks of her prestige and her claims to respect and deference Thus, food itself may connote prestige and thereby reflect the socioeconomic status of an individual

Galdston presented the challenging concept that although people are interested in diets they are not interested in nutrition or even in diets per se "They are interested in becoming slim, in looking younger or younger than they are, and in being attractive " He suggested further that the individual wants many things but not health alone His interest lies in good health in order to *do* or to *be* something

Food, then, has many meanings to many people. To most the nonmetabolic needs of food are strongest. However, the individual concerned with the welfare of others realizes that food can be a major contribution to health. Members of this latter group, through the training for their several specializations, are aware of this important relationship. However, in order to be effective nurses, physicians, or nutritionists, an understanding of the nonmetabolic needs for food must be recognized.

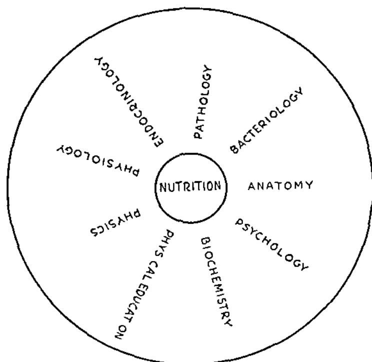


Fig. 1.—Nutrition is at the crossroads of all other medical sciences.

Nutrition has been defined as "the combination of processes by which the living organism receives and utilizes the materials necessary for the maintenance of its functions and for the growth and renewal of its components." Thus it is not an isolated science but is closely interrelated with others. In fact, nutrition has been said to be at the crossroads of all other medical sciences (see Fig. 1). Not only is this true today, but it is possible to trace this interrelationship through the ages from the origin of our present day physiology, biochemistry, and nutrition.

A review of the development of the science of nutrition reveals an interesting history *Hippocrates (the father of medicine,* 460 375 B C) wrote "Let us inquire therefore, what is admitted to be medicine To me it appears that nobody would have sought medicine at all provided the same kinds of food suited men in sickness and in health " Another aphorism, "Growing bodies have the most innate heat, they therefore require the most food for otherwise their bodies are wasted In old people the heat is feeble and they require little fuel as it were " He also expressed the thought that persons who are naturally very fat are likely to die earlier than those who are slender His treatment of patients consisted in dieting, exposure to sunshine, exercise, and psychic diversion

As Hippocrates was the father of medicine, so Lavoisier (1743 1794) was the first to clearly understand and express our basic knowledge of energy metabolism

*Harvey, Mayow, Priestley, Magendie, and many others illus*trate the relationship of nutrition to other disciplines During the nineteenth century major strides were made in the understanding of the function of the living organism In addition, *investigators sought to isolate and identify the materials neces*sary for life Studies attempted to establish the sources of these necessary materials and suggestions were made, as in the words of Prout that "the body is constructed from the foodstuffs ingested and that a diet to be complete must contain *all* three staminal principles (saccharina, oleosa, and albuminosa) "

Nutrition has been called a "twentieth century science" because of the rapid progress in the identification of nutrients found in foods and the functions of these nutrients in the living organism Descriptions of these discoveries and related research make fascinating reading It is important to realize that past research has had a profound effect on present day methods and beliefs

The first textbook of nutrition in this country was written by Graham Lusk, *Science of Nutrition,* and published in 1906 In 1921, Mary Swartz Rose (1874 1941) through her appointment as Professor of Nutrition at Teachers College, Columbia, became the first nutrition professor at any American university

Because of the vast range of material it is beyond the scope of this book to trace the historical development of the science of

nutrition The interested student is referred to the references (Part X) as a source of some of this information However whenever possible reference will be made to past research in the discussion of present trends

The results of recent surveys published by the Bureau of Human Nutrition and Home Economics indicate that for the most part American nutrition has notably improved during the last 40 years There seems to be a shift in the types of foods consumed which results in a decrease in cereal products and an increase in vegetables fruit and milk Although there are seldom cases of frank vitamin and mineral deficiency Dr Russell Wilder suggests there are indications that an indeterminable number of our adult population still suffers from so called "subclinical" or borderline deficiencies

Dr Pearl Swanson in a paper presented at the National Food and Nutrition Institute in 1952 reviewed several studies of the food intake of specific groups In summary she stated "It may be said that although dietary studies in general indicate that the national diet is good there still remain in the picture certain vulnerable groups of individuals that should serve as targets of nutrition education These are children ages 6 to 15 years and in particular adolescent girls mothers of families aged people adult women in the age bracket 30 to 70 years and pregnant women"

The F A O (Food and Agricultural Organization of the United Nations) published a second *World Food Survey* in November 1952 In general it was stated that the diets consumed by sample groups in most of the heavily populated regions of the world are quantitatively deficient "Simply this means that many millions of people do not get enough food to satisfy their hunger" In addition the *Survey* pointed out that the nutritional quality of the diets was even more unfavorable because "even in countries in which the caloric levels are adequate diets often do not contain enough 'protective foods'"

Thus although those concerned with nutrition education can be encouraged by the gradual improvement in the average result of food surveys there are indications that there are many individuals and groups both here in America and in the world who need further assistance to health through proper food

Recently, the difference between buoyant or optimum vs passable health has been appreciated The goal of each individual is happiness, optimum health, and efficiency Fig 2 illustrates that proper food is the hub of the larger wheel of health Good health is important for what it leads to as well as for health itself

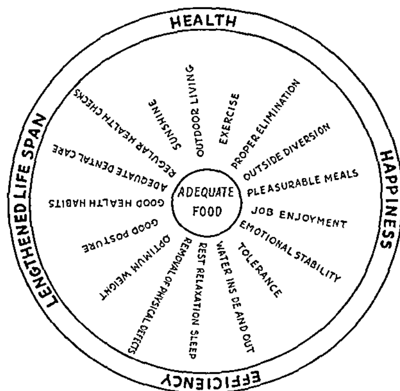


Fig 2—Adequate food is the hub of the larger wheel of health

Today, on the basis of past research, positive health programs are under way in most communities One of the outstanding examples is the work of the F A O and W H O (World Health Organization) of the United Nations Nutrition plays a major role in these programs The enrichment program in America, fluoridation of public water in some cities, diabetes detection week, well baby clinics the school lunch program, and many others illustrate constructive health programs in the United States which recognize the importance of nutrition

Dr Charles Glen King* has pointed out that, practically speaking, nutrition can be called the science of food and its

*King Charles Glen Basic Research and Its Application in the Field of Clinical Nutrition J Clin Nutrit. 1 1 Sept Oct 1952

relation to life and health He also set forth four goals toward which the *nutrition scientists strive in their understanding of* nutrition

> First they (the nutrition scientists) want to be able to identify and measure the concentration of all the useful ingredients in human and animal foods
>
> Second they want to know how each nutrient functions in living organisms and how these functions interlink with one another
>
> Third they want to know the quantitative relationships between nutrient intake and health on a life span basis
>
> Fourth they sense an obligation to assist in the educational activities that will make their work effective in the community at large

The first three of these goals are concerned with the information set forth in the present volume The fourth objective the importance of educational activities is carried out by professional action There are many opportunities such as patient contact in the clinic, ward or home work with mothers groups or in community participation to modify food patterns in accord with present day nutrition concepts and thereby improve health

Thus by incorporating the newer knowledge of nutrition this book may serve as a reference for those who are professionally concerned with nutrition In addition it may serve as an introduction to the science of nutrition to students who are entering their chosen field Practical application of nutrition to specific problems has been included in order to provide meaningful as well as factual information The addition of charts and suggested learning experiences may both aid the graduate and enhance the understanding of students It is toward the over all goal of *improving the health of our population* that this book is directed

Since communities and nations are but large groups of individuals feeding the masses becomes a matter of grave importance Economic prosperity can be reflected in the condition of the dinner table No individual can work efficiently on an inadequate *diet The men of tomorrow will be no stronger than* the children of today, whose growth is dependent upon their

but how much was needed, and how these various factors functioned within the body Recently, labeled molecules and atoms have been used by scientists A given molecule can be labeled with a radioactive atom This molecule, then, can be followed throughout its pathways in the body as long as the radioactivity lasts These isotopes are chemically identical with other atoms of their kind and they can be measured in extremely small quantities Studies of these tracers have contributed extensively to our present concepts of nutrition

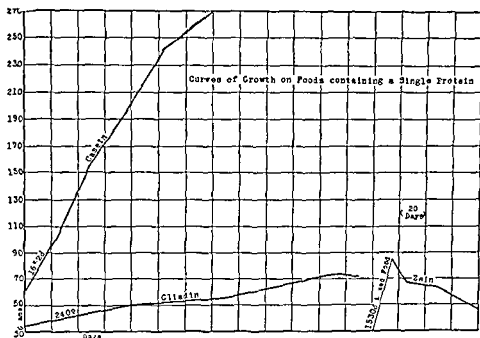


Fig 3—Showing typical curves of growth of rats on diets containing a single protein On the casein food (devoid of glycine) satisfactory growth is obtained on the gliadin food (deficient in lysine) little more than maintenance of body weight is possible on the zein food (devoid of glycine, lysine and tryptophan) even maintenance of body weight is impossible (From Mendel L B J A M A 64 1539 1915)

Our current beliefs about the basic needs of the body are based on past research However, *nutrition is not a static science* New discoveries new methods of research are constantly coming forth and, consequently, our beliefs are changing So, because nutrition is a fast moving science, we today believe that tomorrow *will bring many great discoveries*

These "materials" which are necessary to the functioning of the living organism are often referred to as nutrients By defi

nition a nutrient is a substance which takes part in nourishing the body * A nutrient can function in the body in three ways

1 It can provide fuels which when oxidized in the body release energy

2 It can furnish the substances for the building and upkeep of the skeletal structure and the soft tissues of the body

3 It can supply the materials which are necessary either to regulate the body processes or from which the body can synthesize its own regulatory substances

A single nutrient may function in the body in more than one way Similarly a single food the source of nutrients may provide nutrients which will serve one two, or even all three of the above functions depending on its composition

There are five major classifications of nutrients carbohydrates fats (lipids) proteins vitamins and minerals This is the order in which they will be presented in the present volume For the most part carbohydrates and fats provide fuel for energy although proteins can perform this function This energy value is expressed in terms of calories Proteins and minerals supply the materials for the building and upkeep of the body tissues Again small amounts of fats (lipids) contribute to body cells The body regulators as they are sometimes called are primarily minerals vitamins and proteins However other nutrients may supply regulating power (See Table 1)

Obviously it is difficult to rigidly classify nutrients The grouping suggested in the preceding paragraph represents the primary function of each nutrient However through the information gained from radioactive isotopes important interrelationships among the nutrients have been demonstrated For example it is known that thiamine (one of the members of the vitamin B complex) must be present for the oxidation of glucose These interrelationships will be emphasized as each area is discussed It is sufficient for the present to be concerned with the major functions of each nutrient

The chemical analysis of the body is worth quoting its relative worthlessness in dollars and cents is apparent At the current price of chemicals the body's store is worth something less than two dollars (See Table 2) Macy has said that an adult

*Sherman Henry C Essentials of Nutrition p. 13

TABLE 1

ESSENTIAL NUTRIENTS, PRINCIPAL FUNCTIONS, AND PRIMARY SOURCES

NUTRIENTS	PRINCIPAL FUNCTIONS: PROVIDE ENERGY	PRINCIPAL FUNCTIONS: BUILDING AND UPKEEP	PRINCIPAL FUNCTIONS: REGULATE BODY PROCESSES	PRIMARY SOURCES
Carbohydrates	x			Sugars, starches, cereals, breads, potatoes, root vegetables
Fats	x			Butter, lard, oils, meat fats, nuts, cream
Proteins	x	x	x	Meats, eggs, milk, legumes, cheese
Minerals*				
Calcium		x	x	Milk, cheese, kale, egg yolk
Phosphorus		x	x	Milk, meats, fish, legumes
Sodium			x	Table salt, salted fish and meats, milk, vegetables
Potassium			x	Dried fruits, legumes, cereals, vegetables, lean meat
Chlorine			x	Table salt, salted fish and meats, canned foods
Iodine			x	Sea foods, coastal plants, iodized salt
Iron		x	x	Liver, lean meats, egg yolk, green leafy vegetables, legumes
Copper		x	x	Legumes, liver, lean meats, whole grain cereal and bread
Magnesium		x	x	Legumes, lean meats, cereals, nuts
Manganese			x	Cereals, legumes, liver, green leafy vegetables
Cobalt			x	Green leafy vegetables, whole grain cereals, fruits
Sulfur		x	x	Meats, nuts, legumes fish, hard cheese, egg yolk
Vitamins†				
Fat soluble				
Vitamin A			x	Liver, yellow and green leafy vegetables, fortified margarine
Vitamin D			x	Fish liver oil, fortified margarine, fortified milk
Vitamin E			x	Wheat germ oil, seed oils, navy beans
Vitamin K			x	Green leafy vegetables, pork liver, seeds fruits

*Other minerals which are believed essential are boron arsenic chromium lithium molybdenum rubidium aluminum fluorine, lead barium silicon nickel tin bromine and zinc.

†Other factors which are believed essential are biotin inositol para aminobenzoic acid rutin adenylic acid and vitamin P There may be vitamins yet to be discovered

TABLE 1—CONT'D

NUTRIENTS	PRINCIPAL FUNCTIONS: PROVIDE ENERGY	BUILDING AND UPKEEP	REGULATE BODY PROCESSES	PRIMARY SOURCES
Water soluble				
Ascorbic acid			x	Citrus fruits, fresh fruits, tomatoes
Thiamine			x	Pork, legumes whole grain and enriched breads and cereals
Riboflavin			x	Milk, liver, green leafy vegetables
Niacin			x	Liver, lean meats, legumes, whole grain and enriched breads and cereals
Pyridoxine			x	Rice bran, egg yolk, liver, legumes
Panthothenic acid			x	Liver, lean beef, eggs, whole grain breads and cereals
Choline			x	Egg yolk, soybean, organ meats whole grain breads and cereals
Folacin			x	Green leafy vegetables, liver, lean meats
Vitamin B_{12}			x	Liver, milk, cheese meats

man contains "enough water to fill a 10 gallon jug, enough fat for 7 bars of soap, carbon for 9,000 lead pencils, phosphorus for 2 200 match heads, magnesium for 1 dose 'salts,' enough iron to make a medium size nail, enough lime to white wash a chicken coop, and enough sulphur to rid one dog of fleas "*

Food is the only source of nutrients available to the body As the result of chemical analysis similar foods may be grouped, according to chemical composition, into classes Such grouping is known as the classification of food Details will be found in specific chapters

Rarely are foods composed of a single constituent Sugar, which is pure carbohydrate, dry gelatin, which is pure protein, and olive oil, cottonseed oil, and some other oils, which are pure fat, are exceptions In general, all the several constituents are present in food, but in varying amounts A food may be said to belong to a certain group only if that nutrient is present to such an extent that, when the food is eaten in

*Macy Icie G Hidden Hunger p 108—A 154 pound man contains the following [illegible] lb calcium 1¼ lb phosphorus a little more than ½ lb potassium 1 lb table salt 5 oz sulfur 1 oz magnesium less than 1 oz iron and the trace elements.

cules to simple, soluble form so that they may be absorbed. The process of digestion takes place along the gastrointestinal tract. In the mouth, which is the beginning of the gastrointestinal tract, the carbohydrates are the only group to be affected. In the stomach, the next organ in digestion, the proteins are partially broken down, and possibly some of the fats. It is in the small intestine, with digestive agents from the pancreas and the liver as well as the small intestine, that the carbohydrates, fats, and proteins are reduced to their simplest form. The end products of carbohydrates (the starches and sugars) are three "simple" sugars: glucose, galactose, and fructose; of fats, fatty acids and glycerol; and proteins, their component amino acids.

There are portions of foods which are not available to the body for nourishment. These are primarily tough fibers known as cellulose. These, along with other solid waste materials, pass into the last section of the gastrointestinal tract, the colon. The process of **excretion** is that of eliminating this residue from the body.

The end products of digestion: the simple sugars, fatty acids, glycerol, and amino acids, are ready for **absorption**. This is a complicated function and some of our most recent data concern the interaction of other elements in this intricate process. At this time, it is sufficient to remark that the nutrients pass through the walls of the small intestine into the circulatory system.

The **distribution** of the nutrients in the body is one of the functions of the human circulatory system. The absorbed nutrients are carried first to the liver and then quickly about the body. A complete circuit of the body takes only about forty seconds.

Some nutrients can, if necessary, serve the body in several ways. When there is no immediate need for the specific end products of digestion, the nutrient passes into what some scientists call the "metabolic pool." From this metabolic pool, the nutrient may ultimately serve one of many functions. Many of the needed "adjustments" to prepare the nutrient for other functions are believed to be made by the liver with the help of certain vitamins and minerals. The usual pathways in the **utilization** of nutrients along with other possible secondary services are diagrammatically presented in Fig. 4.

This cursory treatment of metabolism will be expanded in later sections of this book However, it was felt that an outline of the over all functions of the nutrients might prove helpful as a study guide

One of the most important contributions to our understanding of metabolism in recent years has been the *concept of "a dynamic state of affairs in all body tissues"* Previously, it was believed that a static condition existed within the body In other words, a given molecule of adipose tissue was thought to remain inert, after its deposition, for many years The body was believed to use the fuel foods as they were ingested, and only if an emergency arose was the inert molecule of adipose tissue utilized

Possible Pathways of Carbohydrates Fats and Proteins

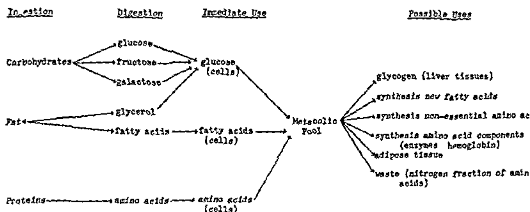


Fig 4

However, the use of radioactive isotopes suggests that this is not the case The concept now accepted is that there is constant use and replacement in all body tissues of nutrients This "dynamic state of affairs" is held to be true in such "per manent" structures as bones, tendons, and adipose tissue

Of the three fundamental questions set forth in this chapter, how we know the basic needs of the body, how factors function within the body and how much of these factors we need for op timum health only the last remains

Until 1935, various standards of recommended amounts of nutrients were suggested by current investigators These changed from time to time, of course, as no standard is considered

final In 1935 the *League of Nations formulated standards* (minimum requirements) which were based on the information then at hand These standards were the first which were the result of a concerted group effort

Late in 1940, the Food and Nutrition Board of the National Research Council was organized, with the purpose of advising on problems in nutrition in connection with national defense The need for standards on which some degree of general acceptance could be expected was immediately recognized In May, 1941 the *first dietary allowances* were adopted by the Board This action followed critical consideration of tentative allowances and thereby represents the combined judgment of more than fifty persons qualified to express an opinion

The second edition of the *Recommended Dietary Allowances* was published in August, 1945 The third edition was released in October 1948, and the fourth in November, 1953 Each edition represented the same careful examination of existing information in the light of recent discoveries that characterized the first table

As indicated by the Food and Nutrition Board the recommended dietary allowances are to be interpreted literally that is the data set forth in Table 3 are to be understood as "representing levels of nutrient intakes which the Food and Nutrition Board recommends as normally desirable goals or objectives" It is important to understand that the recommendations are not considered as requirements *The recommendations,* in the words of the Board *are intended to represent not merely the literal (minimal) requirements of the average individual but levels enough higher to cover substantially all individual variations in the requirements of normal people*

When studies on man have been conducted in which the intakes of certain nutrients are increased above the level which is just sufficient to prevent obvious deficiency symptoms substantial improvements in growth and function have been clearly indicated The allowance of intake above the critical level for each nutrient serves a twofold purpose It permits additional benefits for the individual and it provides a "cover" for individual variations Thus the *allowances are in keeping with our present philosophy of "buoyant" health vs passable health*

TABLE 3—CONT'D

	AGE YR	WEIGHT KG (LB)	HEIGHT CM (IN)	CALORIES	PROTEIN GM	CALCIUM GM	IRON MG	VITAMIN A I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG	VITAMIN D I U
Children	1-3	12 (27)	87 (34)	1 200	40	1.0	7	2 000	0.6	1.0	6	35	400
	4-6	18 (40)	109 (43)	1 600	50	1.0	8	2 500	0.8	1.2	8	50	400
	7-9	27 (59)	129 (51)	2 000	60	1.0	10	3 500	1.0	1.5	10	60	400
Boys	10-12	35 (78)	144 (57)	2 500	70	1.2	12	4 500	1.3	1.8	13	75	400
	13-15	49 (108)	163 (64)	3 200	85	1.4	15	5 000	1.6	2.1	16	90	400
	16-20	63 (139)	175 (69)	3 800	100	1.4	15	5,000	1.9	2.5	19	100	400
Girls	10-12	36 (79)	144 (57)	2 300	70	1.2	12	4 500	1.2	1.8	12	75	400
	13-15	49 (108)	160 (63)	2 500	80	1.3	15	5,000	1.3	2.0	13	80	400
	16-20	54 (120)	162 (64)	2 400	75	1.3	15	5 000	1.2	1.9	12	80	400

*In planning practical dietaries the recommended allowances can be attained with a variety of common foods which will also provide other nutrient requirements less well known the allowance levels are considered to cover individual variations among normal persons as they live in the United States subjected to ordinary environmental stresses common thereto [Other nutrients discussed in the text, NRC Bulletin No 30, include Fat p 23 Water p 23 Sodium Chloride p 23 Phosphorus p 24 Copper, p 24 Iodine p 24 Vitamin B_6, p 25 Vitamin B_{12}, p 25 Folacin, p 26, Biotin p 26, Pantothenic Acid p 26, Vitamin K p 27 Fluorides p 24 and Other Trace Elements p 24]

†These calorie recommendations apply to the degree of activity for the reference man and woman For the urban "white collar" worker they are probably excessive In any case the calorie allowance must be adjusted to the actual needs of the individual as required to achieve and maintain his desirable weight

‡The recommendations for infants pertain to nutrients derived primarily from cow's milk or commercial milk preparations There should be no question that human milk is a desirable source of nutrients for infants although intakes may not provide the recommended levels of certain nutrients e g protein calcium thiamine and riboflavin

§During the first month of life desirable allowances for many nutrients are dependent upon maturation of excretory and endocrine functions Therefore no specific recommendations are given



Fig 5.—The Basic Seven Wheel of Good Eating (Reproduced by permission of the American Institute of Baking.)

tive content Therefore, the Basic Seven should include variety within each group as well as the seven groups each day

As each nutrient is discussed throughout the book, its relationship to the Basic Seven will be emphasized The section on planning the adequate diet for the family will be based on the recommendations of the Basic Seven It is important, now, to realize that the Basic Seven is a nontechnical application of centuries of research in nutrition and allied sciences Research is continuing to seek answers to the three questions discussed in this chapter, the basic nutritive needs of the body, how these nutrients function in health and disease, and how much of the nutrients we need for optimum health

Review Questions

1 List some of the ways in which the basic needs of the body are determined
2 What is meant by the term "nutrient"?
3 How can nutrients function within the body?
4 List the specific functions of each nutrient
5 What is the difference between the terms ingestion, digestion, absorption and utilization?
6 What is meant by the phrase "a dynamic state of affairs"?
7 What is the underlying philosophy of the Recommended Daily Allowances?
8 What are the uses and limitations of the allowances?
9 What is the Basic Seven?

Suggested Projects

1 Record your food intake for one week Carefully note the way in which food is prepared and the portions consumed Be sure to include all food ingested such as chewing gum, in between meal snacks, and sauces This record can be used later in evaluating your nutrition intake
2 List the questions and problems you encountered in recording your diet Do you think that the homemaker would have the same problems?

CHAPTER 3

THE CARBOHYDRATES

The carbohydrates are organic compounds synthesized by plants. Chemically they are classified into three groups: monosaccharides, disaccharides, and polysaccharides. Carbohydrate foods are an inexpensive source of energy and, consequently, form the greatest portion of our diet. Grain, grain products, vegetables (legumes, tubers, root vegetables), sugars, syrups, candy, and jellies are all rich sources of carbohydrates. Other sources include fruits and green leafy vegetables. Cooking renders carbohydrate-containing foods more accessible to digestive enzymes. Many of these foods supply other important nutrients as well as energy.

The primary **function of carbohydrates** is to provide energy. Thus they supply the major part of our daily food. In addition, carbohydrates have an important relationship in protein and fat metabolism which will be discussed in Chapter 6. Carbohydrates exist in the body as glucose, a constant constituent of the blood which supplies the cells with energy, and as glycogen which serves as a store of reserve energy.

Chemically they are organic compounds composed of carbon, hydrogen and oxygen. They are synthesized by plants under the influence of sunlight from the carbon dioxide of the air and water. In plant form carbohydrates are ingested by the animal and in the animal body are again completely broken down (oxidized) into carbon dioxide and water: $C_6H_{12}O_6 + 6O_2 = 6CO_2 + 6H_2O$. They are hydrates of carbon.

Carbohydrates can be classified into three major groups depending upon the complexity of the molecule: The monosaccharides or simple sugars, disaccharides which yield two simple sugars upon hydrolysis, and polysaccharides which yield more than two simple sugars upon hydrolysis or digestion.

Monosaccharides—($C_6H_{12}O_6$)

Glucose, known also as grape sugar, dextrose, and corn sugar, is found in abundance in fruits and plant juices. Grapes and sweet corn are especially rich sources of this sugar. As corn syrup it has become popular as the carbohydrate for modification of baby for

mulas, in candy making, jellies, etc. It results from the hydrolysis of other carbohydrates during the course of digestion and is the form in which sugar circulates in the blood.

Fructose is known also as fruit sugar and levulose. A mixture of glucose and fructose is known as invert sugar. Honey is such a mixture. Fructose is present with glucose in fruits and vegetables and serves, as does glucose, as a source of liver glycogen. These two sugars are interconvertible.

Galactose results, with glucose, from the hyrolysis of lactose or milk sugar. It, too, may be converted into glycogen. It does not occur free in nature. Compounds of galactose, or galactosides, occur in nervous tissue. Two molecules of galactose combine to form lactose.

The monosaccharides are crystalline, readily soluble, sweet, and are very easily digested.

Disaccharides—($C_{12}H_{22}O_{11}$)

Sucrose is ordinary table sugar. It is sometimes called cane sugar or saccharose. It is widely distributed in nature, usually mixed with glucose and fructose, in fruits and plant juices. Commercial sucrose is prepared from either sugar cane or sugar beet. On hydrolysis sucrose yields one molecule of glucose and one of fructose.

When part of the sucrose has been crystallized from cane sugar or beet syrup, molasses is left. Molasses contains much of the sucrose, the ash, and other constituents of the original syrup. It is of value as a source of iron and has recently been found to be a source of some of the B vitamins.

The chemical structure of maple sugar is identical with that of sucrose. This concentrated sap of the sugar maple tree gains its characteristic flavor from adhering substances.

Lactose yields equal parts of galactose and glucose upon hydrolysis. It is the form in which carbohydrate occurs in milk. Commercial lactose is prepared from whey, the by product in the manufacture of cheese. Milk of all species of animals contains lactose in amounts from 4 to 8%. Lactose is less sweet and less soluble than sucrose. Its chief use is in the diet of infants and invalids.

Maltose results from the action of a specific type of enzyme (amylase) upon starch. This action occurs during the germination or sprouting of cereals. Malt, usually derived from barley, is frequently used for its unique flavor as a sweetener of cereal products and in the preparation of malted drinks.

Disaccharides are crystalline, sweet, soluble, and easily digested. If abnormal conditions exist in the gastrointestinal tract, however, the ingestion of disaccharides may result in fermentation and gas formation and acute distress.

Polysaccharides—($C_6H_{10}O_5$)$_n$, as the formula indicates, yield more than two molecules of simple sugar upon hydrolysis.

Starch is the form in which most plants store their food supply. In fruits this starch is converted into glucose as ripening proceeds, with resulting sweetness. Starch constitutes one half to three fourths of the solid matter of cereal grains. Through starch splitting enzymes or acid hydrolysis, starch is converted through dextrins and maltose into glucose. Starch is not soluble in cold water, but in hot water it is absorbed and the starch grains swell and rupture.

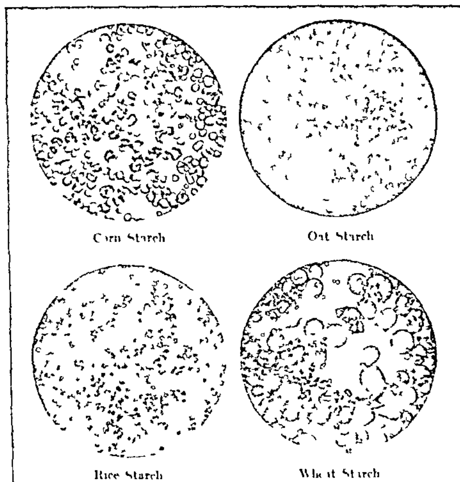


Fig. 6.—Starch grains magnified many times. (From Leach and Winton, Food Inspection and Analysis, John Wiley & Sons, Inc.)

Dextrins are intermediate breakdown products between starch and sugar. They are more soluble than starch and are slightly sweet to the taste. Toasting of bread dextrinizes some of the starch with a resulting flavor change. The caramelization of sugar produces a similar reaction.

Dextrin in solution is sticky, and this property is utilized commercially in the adhesive substance on postage stamps

Glycogen is frequently called animal starch, since carbohydrate is stored in this form in the animal body By digestion vegetable starch is broken down into glucose and then rebuilt into animal starch or glycogen in the liver, where it is held for future use As much as 200 to 300 gm may be stored in the human liver In addition, glycogen is present in every body cell

Cellulose is the structural portion of plants It forms the framework in which the starch granules are deposited It is insoluble and is not digested by enzymes present in the human gastrointestinal tract, *although herbivorous animals are able to utilize it Cellulose* is valuable as roughage, unless contraindicated in gastrointestinal abnormalities When hydrolyzed with acid, cellulose yields glucose



Fig 7—*Changes of starch grains in cooking a Cells and starch grains in a raw potato b in a partially cooked potato c in a thoroughly boiled potato* (Courtesy United States Department of Agriculture)

Cellulose is important commercially in the preparation of collodion, celluloid, Cellophane, mercerized cotton, rayon, paper, and lacquers

Inulin is the starch of dahlia tubers of Jerusalem artichoke, mushrooms, and possibly, to some extent, is found in other vegetables Inulin is not digestible, and for this reason is sometimes used in diet adjustment

Agar agar is the *hemicellulose* (cellulose like material) of seaweed It has no food value but is used medicinally

Pectin is the hemicellulose which gives fruits the property of jelling It occurs in varying amounts, but to the greatest extent in unripe fruit

The polysaccharides vary in solubility and digestibility *They have* little or no flavor, and are amorphous, not crystalline

In years past, carbohydrates formed the bulk of the normal diet, supplying from 45 to 65% of the total calories Today however, they are used less abundantly Not more than 50% of the calories are usually supplied by carbohydrate The range

is rather 40 to 50% except in low cost diets where, of necessity, cereals must be used in large amounts They are bland in flavor, least costly of the foodstuffs, and occur in such variety that they are well adapted to liberal use Deviation from the range of 40 to 50% of the calories (4 to 5 gm per kilogram of body weight, or a total daily intake of 200 to 400 gm) is at times

Food Value in a Grain of Wheat

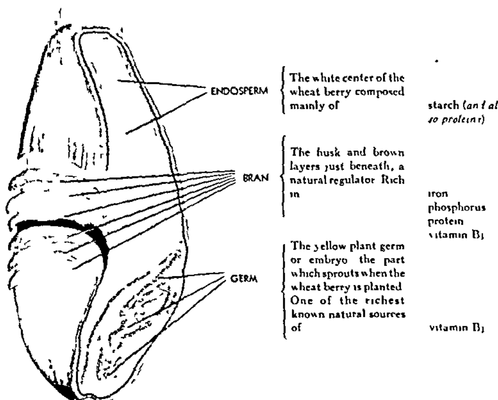


Fig 8.—Food value in a grain of wheat (Adapted from information supplied by the [illegible] Research Laboratory)

necessary in conditions such as diabetes, hypoglycemia, liver disorders, and epilepsy Not only do foods high in carbohydrate value supply energy but, in addition, they often provide a varying amount of protein, several minerals, and vitamins One cannot discuss carbohydrate foods without considering these important additional contributions

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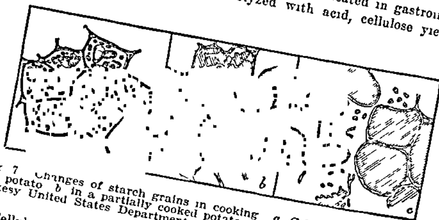


Fig 7 Changes of starch grains in cooking a, Cells and starch grains in a raw potato b in a partially cooked potato c, in a thoroughly boiled potato (Courtesy United States Department of Agriculture)

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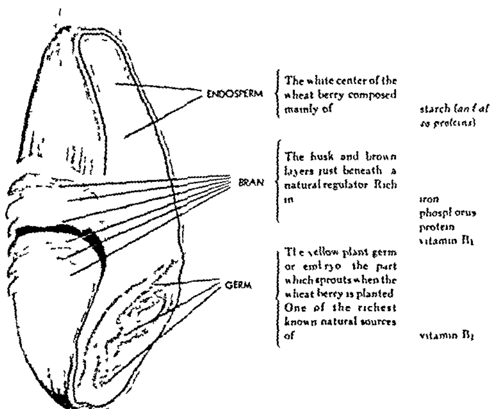


FIG. 8.—Food value in a grain of wheat. (Adapted from information supplied by the Ralston Research Laboratory.)

necessary in conditions such as diabetes, hypoglycemia, liver disorders and epilepsy. Not only do foods high in carbohydrate value supply energy but in addition, they often provide a varying amount of protein, several minerals, and vitamins. One cannot discuss carbohydrate foods without considering these important additional contributions.

Carbohydrate food may be considered in four main groups: cereals and cereal products, vegetables, fruits, and "concentrated sweets" Of these, the cereal and cereal products form the largest fraction of the usual diet. This group includes cereal in many forms such as flour, bread, cakes, pastries, dry cereals, and specialized products The choice of cereal may be influenced

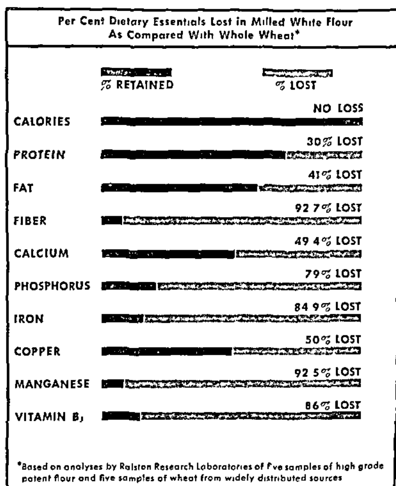


FIG 9—Dietary essentials lost in milling (Compiled by the Ralston Company)

by ethnic patterns and agricultural possibilities In the United States, wheat has been reported to furnish approximately 25% of the total calories consumed, whereas, in the Far East, rice normally provides about 70% of the food supply (in terms of calories). Oats and corn are also widely used by the American people

Wheat is approximately 11% water 12% protein 2% fat 71% carbohydrate 2 to 3% cellulose and 2% mineral matter The character of the protein differs in the cereals the principal protein of wheat is gluten a combination of gliadin and glutenin Gluten gives wheat flour its peculiar elastic property

Cereal grains are similar in structure and consist of three parts the bran coat the body of the grain or endosperm, and the germ

In the process of milling the bran layers and germ are removed Unfortunately this results in a flour or starch essentially devoid of minerals and vitamins The following tabulation gives the percentages of protein carbohydrate fat and other constituents in the various parts of the wheat

	PERCENTAGE				
	PROTEIN	CARBOHYDRATE	FATS	FIBER	MINERALS
Endosperm	10–12	76	1	0.25	0.40
Bran	16	44	3.5	18.0	6.0
Germ	25–40	30–50	8–15	1.8	5.7

Since 1941 under the stimulus of the National Research Council there have been several changes made each of which brings about an increase in the nutritive value of breads and flour

In the most widely used method the crystalline vitamins are added giving an "enriched" flour To be sold as such flour must conform to certain specifications An "enriched" flour *must* contain thiamine niacin riboflavin and iron within the amounts given below and *may* in addition contain calcium and Vitamin D

The newer standards proposed for enriched flour differ from the original The increases are designed to keep pace with the changes in the knowledge of dietary needs according to evidence presented by technical authorities (from food industries and representatives of the Food and Nutrition Board of the National Research Council)

The bread enrichment program is a definite step forward in government encouragement for better national nutrition Enriched bread and flour are unchanged in flavor and compare favorably with the coarser whole wheat products Without enrichment many more American diets would be low in thiamine riboflavin niacin and iron In addition bakers may, and many

TABLE 4

ENRICHMENT STANDARDS[1]

(All Figures Represent Milligrams per Pound)

PRODUCT	THIAMINE (B_1) MIN	THIAMINE (B_1) MAX	RIBOFLAVIN (B_2) MIN	RIBOFLAVIN (B_2) MAX	NIACIN MIN	NIACIN MAX	IRON MIN	IRON MAX
Enriched bread, or other baked products	1.1	1.8	0.7	1.6	10.0	15.0	8.0	12.5
Enriched flour*	2.0	2.5	1.2	1.5	16.0	20.0	13.0	16.5
Enriched Farina†	1.66	—	1.2	—	6.0	—	6.0	—
Enriched macaroni products‡	4.0	5.0	1.7	2.2	27.0	34.0	13.0	16.5
Enriched noodle products‡	4.0	5.0	1.7	2.2	27.0	34.0	13.0	16.5
Enriched corn meals	2.0	3.0	1.2	1.8	16.0	24.0	13.0	26.0
Enriched corn grits§	2.0	3.0	1.2	1.8	16.0	24.0	13.0	26.0
Enriched milled white rice¶	2.0	—	**		16.0	—	13.0	—

[1]The Roche Review of Enrichment Requirements (Courtesy Hoffmann LaRoche Inc Nutley New Jersey)

The maximum and minimum levels shown above for enriched bread enriched flour enriched Farina enriched macaroni spaghetti and noodle products enriched corn meal and corn grits are in accordance with Federal Standards of Identity or State laws Act No 183 of the Government of Puerto Rico requires the use of enriched flour for all products made wholly or in part of flour This includes crackers pretzels etc

The levels of milled white rice are officially those of the Government of Puerto Rico These levels are commonly accepted in United States domestic and export marketing and are based on the recommendation of the Committee on Cereals Food and Nutrition Board National Research Council

*In enriched self rising flour calcium is also required between limits of 500 to 1500 mg per pound

†No maximum levels have been enforced

‡Levels allow for 30 to 50% losses in kitchen procedure

§Levels must not fall below 85% of minimum figures after a specific rinsing test described in the Federal Standards of Identity

¶Levels must not fall below 85% of levels shown after washing and rinsing

**Omitted in the United States and Puerto Rico but used in certain Far Eastern countries to a minimum level of 1.2 mg per pound

do, add milk solids, wheat germ, or soya flour The addition of milk solids improves the protein quality, adds calcium, riboflavin and improves flavor The combination of vitamin and milk enrichment is highly desirable At the beginning of 1954 twenty six states, Hawaii, and Puerto Rico had enacted bread and flour enrichment laws (Alabama Arkansas, Colorado, Georgia Indiana, Kansas, Kentucky, Louisiana, Maine, Massachusetts, Mississippi, Nebraska New Hampshire, New Jersey, New York, North Carolina, North Dakota, Ohio, Oklahoma, Rhode Island South Carolina, South Dakota, Texas, Washington, West Virginia and Wyoming)

The Puerto Rican law is unusual in that it requires wheat flour and all products made from it to be enriched

Bread is 60% flour The thiamine, niacin and iron in yeast breads are but slightly affected by baking A pound loaf of bread yields eighteen slices

Graham flour is the whole wheat kernal ground

Entire wheat flour (contrary to what the name would indicate) is prepared from wheat minus some of the five or six outside bran layers

Macaroni spaghetti and vermicelli are prepared from wheat with a high gluten content Although enrichment of these products is not required in any state there is quite a trend on the part of macaroni and spaghetti manufacturers now to enrich their products

Corn is similar in structure to wheat but differs in its protein The proteins of corn are zein and glutelin Corn contains less protein minerals and cellulose than wheat but has more fat and carbohydrate Since the cellulose of corn is low (1 7%) only the outer skin need be removed before milling There are several states which have laws regarding the enrichment of corn meal products and are mandatory in so far as degerminated meal and grits are concerned These states are Alabama Georgia Mississippi North Carolina and South Carolina This represents a progressive step in public health for corn meal is a staple of the diet in this area

Cornstarch and corn syrup are prepared from the endosperm of the corn the first by fine grinding and the second by hydrolysis of the cornstarch by dilute acid

Rice another staple in the diets of some ethnic groups is not affected by either State or Federal standards for enrichment However it is possible that specifications will be adopted shortly Puerto Rico does have an enriched rice law and there seems to be a trend among some manufacturers to enrich rice The Philippines which are no longer a United States possession have taken action toward rice enrichment

Today numberless cereal products are available puffed flaked kernels finely ground and others All have their place in the diet and all lend variety Labels should indicate the composition Recently manufacturers have added vitamins or minerals or have irradiated their products The ready to serve packaged and fortified cereals are naturally the more costly, and certain preparations have a slightly lower nutritive value due

to the high heat used in their preparation, than the original grain Dry cereals do not seem to be covered by any State or Federal enrichment laws However, whenever any product makes a vitamin claim (which is the case with some of the dry cereals), it is immediately classified as a special dietary food and is thereby subject to the Food and Drug Administration's label regulations To meet these, a declaration of the vitamin content and a statement of the percentage of minimum daily requirement supplied by the recommended daily portion of the food must appear on the label

The statement is occasionally made that oatmeal causes rickets A brief explanation may be in order Cereals do contain phytic acid, which has the power to combine with calcium thus converting the calcium into a nonutilizable form (a phytate) Cereals also contain an enzyme phytase which can hydrolyze this phytate The amount of the phytase present in cereals is variable Oats have little, wheat much more and rye more than wheat Long cooking, as in the cooking of old fashioned porridge destroys this enzyme thus preventing its normal action of breakdown of the phytate and release of the calcium The shorter cooking time coupled with the higher content of enzyme in other grains results in greater release of calcium Therefore the studies which showed that rickets could be produced on a diet containing a large amount of oatmeal gave rise to a popular misinterpretation of facts Practically, it is not of importance for human beings who eat diets of variety rather than subsisting almost entirely on the old fashioned oatmeal Not only do cereals contribute the bulk of the calories in the diets throughout the world but through **enrichment** and natural sources they supply some protein and several B vitamins (primarily thiamine riboflavin and niacin) and the important minerals iron and calcium

Within the last several years a second type of enrichment has come about The idea was the brain child of McCay at Cornell who with Flack and Silva developed a new bread formula known as the Cornell formula To enriched unbleached flour is added 2% wheat germ, 6% full fat soy, and 8% powdered skim milk The result is a delicious flavored good textured excellent toasting bread at a cost of approximately one cent a loaf more than the standard white bread The only requirement for any

one desiring to use the formula is that the ingredients as indicated above be clearly listed on the wrapper The formula is open '—a statement of ingredients by ' open formula''—giving the consumer protection which is a desirable trend The minimum basic ingredients of breads is controlled by Government regulation Additions are justifiably held as ' trade secrets '

The **vegetables** may be divided into three main classes legumes root and tuber and green leafy Each group varies in starch sugar protein mineral and vitamin content In the past vegetables were subdivided according to their carbohydrate content into 5 10 15 20% vegetables indicating that 5 10 15 20 gm of carbohydrate is contained in 100 gm or in approximately ½ cupful of vegetables even another grouping has been 3 6 9 12 15 18% vegetables The composition is variable with the soil on which they are raised variety season and handling and these divisions are therefore only *approximate* Such grouping will be found in the Appendix However the recent trend is to have two main groupings of vegetables and accept an average value as the carbohydrate content in each group Group A which contains *negligible* amounts of carbohydrate when used in reasonable amounts and Group B which contains *approximately* 7 gm of carbohydrate per average serving of ½ cup (100 gm) A discussion of this new approach will be found in Chapter 30

The **legumes** include such vegetables as dried navy and kidney beans green or dried lima beans green or dried peas and lentils In addition to their high carbohydrate value these foods are important sources of proteins The quality of this protein and its place in the diet will be discussed later The legumes may also contribute thiamine small amounts of riboflavin and some iron to the diet Some ascorbic acid may be found in fresh legumes

The second class of vegetables and the one which ranks second in carbohydrate value is the **roots and tubers** Chief among these is the potato According to the U S Department of Agriculture the per capita consumption of white potatoes is 12› pounds per year Potatoes are high in starch and consequently caloric value and are of low fiber content They also may be considered as a moderate source of iron ascorbic acid (in fall and early winter) and thiamine The sweet potato ranks second in vegetable consumption in the United States In comparison,

it is higher in carbohydrate value than the white potato, and it may be considered as a rich source of vitamin A It contributes some thiamine ascorbic acid (which is lost during storage), and iron Other commonly used root vegetables are carrots (rich in carotene), turnips, and beets

While not of this classification, the squash, Hubbard acorn, or butternut, provides a carbohydrate value similar to that of the root vegetables In addition, these squash are rich in carotene

The *third class* of vegetables, the leafy, includes such plants as cabbage, kale, chard, broccoli, spinach, turnip greens collards, lettuce and beet greens These vegetables are relatively low in carbohydrate However, as a group they are outstanding sources of certain minerals and vitamins Calcium and iron are the minerals supplied and these foods are all excellent sources of vitamin A or, rather, carotene (the substance from which vitamin A is formed) Roughly, the degree of potency of carotene corresponds to the depth of color found in the leafy vegetables In the fresh state, the leafy vegetables are rich sources of vitamin C However, as will be discussed later, much of this vitamin, which is initially present in some vegetables is lost during handling and cooking

Tomatoes, botanically a fruit, take their place in the American dietary as an important vegetable This importance is due to two factors one, their excellent nutritive value, and, two the fact that *they rank third among vegetable consumption* The tomato in its various forms ranks first in canned vegetable consumption Although the tomato is low in carbohydrate value, it is a good source of ascorbic acid The acidity of the tomato protects this vitamin against any considerable loss in cooking Although containing some carotene and some B vitamins the tomato is not considered an important source of these nutrients.

Fruits may likewise be grouped according to carbohydrate content Some fruits like bananas dates and figs have high fuel value Others like watermelons pears strawberries and rhubarb have low caloric value In general fruits have less than 2% protein and except for avocado pears and olives have less than 2% fat Their carbohydrate content varies from 5 to 20% in the fresh fruits and from 60 to 80% in the dried fruits

Fruits owe their distinctive flavors to the volatile oils and acids The malic acid in apples tartaric in grapes, citric in lemons oxalic in tomatoes are formed in the breakdown of the

starches Fruits are valuable in preserving the alkalinity of the blood, since they form alkaline carbonates during the digestive process During the ripening of fruits, the starch is converted into sugars, at which time they become readily digested

Fruits are rich sources of vitamins and minerals (see discussion under these headings) Their carbohydrate content varies according to the form in which fruits are purchased and consumed Fruits are available in the fresh state, canned in sugar syrup or water, dried, stewed, frozen and preserved Fruit juices also form a major part of the American diet pattern Not only does the carbohydrate content vary according to the processing the fruit receives, but the nutritive value is also affected

Although fresh fruits do not contribute appreciable amounts of carbohydrate (they are roughly 10%) dried fruits, "syrup pack" and frozen fruits (which are usually packed with sugar) are doubled and sometimes tripled in carbohydrate, hence, fuel value For the most part the vitamin and mineral values of dried fruits are appreciably more than those of fresh fruits, whereas the nutritive value of canned fruits is somewhat lower The vitamin and mineral values of frozen fruits seem to be slightly lower than the fresh and approximately the same as the canned fruits As mentioned previously, the vitamin and mineral content of fresh fruits and vegetables can vary considerably according to the method of handling

As a group, fruits are important sources of ascorbic acid certain of the B complex vitamin A, iron, and some other minerals The citrus fruits are exceptionally rich in ascorbic acid and cantaloupe strawberries and apples (to a lesser extent) are also good sources of this vitamin Apricots yellow peaches and cantaloupe contribute vitamin A to the diet A discussion of the contribution of fruits to enhance the vitamin and mineral values of the diet will be presented in respective chapters

Obviously, jams and jellies made from fruits and sugar are concentrated carbohydrate foods By the time the fruit has undergone the preparation and cooking process, in addition to "dilution" with sugar the vitamin value has been markedly reduced Since such foods have little more than caloric value, they should not be permitted to crowd out foods which will supply not only calories but vitamins and minerals as well

TABLE 5

COMPARATIVE AMOUNTS OF CARBOHYDRATES IN SOME COMMON FOODS

FOOD	PROTEIN %	FAT %	TOTAL CARBOHYDRATE %	ASH %	WATER %	CALORIES (100 GM PORTION)
Apple (raw)	0 3	0 4	14 9	0 3	84 1	58
Banana	1 2	0 2	23 0	0 8	74 8	88
Dried prune (uncooked)	2 3	0 6	71 0	2 1	24 0	268
Orange juice	0 8	0 2	11 0	0 4	87 5	44
String bean (cooked)	1 4	0 2	4 7	1 2	92 5	22
Dry navy bean (raw)	21 4	1 6	61 6	3 9	11 5	338
Celery (raw)	1 3	0 2	3 7	1 1	93 7	18
Spinach (cooked)	3 1	0 6	3 6	1 9	90 8	26
Carrot (raw)	1 2	0 3	9 3	1 0	88 2	42
Potato (baked)	2 4	0 1	22 5	1 2	77 8	83
White bread	8 2	3 3	52 3	1 7	34 5	276
Toasted white bread	9 7	3 7	59 0	2 1	25 5	313
Oatmeal (cooked)	2 3	1 2	11 0	0 7	84 8	63
Cornflakes	8 1	0 4	85 0	2 9	3 6	385
Sugar (granulated)	—	—	99 5	—	0 5	385
Candy (fudge)	1 7	11 3	81 3	0 7	5 0	411
Molasses (medium)	—	—	60 0	8 5	24 0	232
Jelly	0 2	—	65 0	0 3	34 5	252

Adapted from U S Department of Agriculture Handbook No 8 Composition of Foods Raw Processed Prepared

Nuts properly belong to the fruit group but because of their composition are discussed in the chapter on Fats

The major difference between fruits and vegetables is that of the form in which the carbohydrate exists In fruits—in the ripened stage—the carbohydrate is sugar, in vegetables it exists as a starch In addition, most fruits have a mild laxative action These differences may be used clinically but have no significance in the normal diet

When one reviews the basic function of each part of the plant the relative carbohydrate value is clear For example, the leaves which are commonly referred to as the "manufacturing part of the plant" are high in cellulose structure and low in carbohydrate value Spinach, kale, and cabbage will be found among the 3% vegetables On the other hand, the root serves as a "storage house" for the plant There one will find a relatively high carbohydrate value As the plant matures, the concentra tion of carbohydrate increases This may be illustrated by the difference between "new" potatoes and "old" potatoes, "young"

carrots and "old" carrots The stalk of the plant is called the "roadway" and consequently has little carbohydrate value Celery, rhubarb and asparagus are examples of this part of the plant Similarly the flower having no need to store food for the plant is low in carbohydrate The cauliflower Brussels sprout and broccoli are from this part The fruit of the plant represents the food which the seed needs to begin life and consequently is high in carbohydrate Like the root as the plant matures the fuel value increases Most fruits are found in this category as well as a few vegetables and the cereals Of course there are many exceptions to this classification but such a grouping may serve as a guide in recalling the relative carbohydrate content of foods derived from plants

The fourth group of carbohydrate foods may be called "**concentrated sweets** and includes such items as sugars syrups molasses honey candy and sweetened beverages The consumption of sugar in the United States is high an estimated 100 pounds per capita or ½ pound per day per person White sugar and its products frostings candy and syrups are highly concentrated carbohydrates Others of this group such as brown sugar corn syrup maple syrup and maple sugar contribute small amounts of calcium and iron Honey contains a small amount of some members of the B complex and some vitamin C Molasses is an excellent source of both calcium and iron Except in the case of molasses the nutrients other than carbohydrate are so small that the contribution is negligible Blackstrap molasses is defined as the dark thick syrup remaining after the economic exhaustion of crystalline sugar (sucrose) In recent years many extravagant claims have been made in relation to its therapeutic value which have no basis in scientific investigation The nutritional value it contains is potassium and magnesium (both of which are plentiful in the average diet) some calcium and some iron and copper The latter two are usually in the form of insoluble compounds which therefore have no food value Blackstrap molasses seems to have considerable quality as a laxative

The **purpose of cooking** food is to improve palatability and render it more easily and completely available to the digestive enzymes Carbohydrate foods are no exception In starch foods cooked in moisture such as cereals and starchy vegetables (po

tatoes), the encasing membrane of the starch molecule swells and ruptures (see Fig. 7), a process known as gelatinization. Cooking of vegetables dissolves the intercellular material which binds the cells of the cellulose together. This serves the dual purpose of softening the cellulose structure, thereby increasing its palatability and rendering the carbohydrates, minerals, and vitamins more available to the digestive process For the most part, the cooking of fruits and sugars serves to enhance the palatibility rather than to improve the digestibility. Correct vegetable and fruit preparation is also concerned with the retention of vitamins and minerals which will be discussed later (see Chapters 11, 12, and 13).

Review Questions

1. What are the carbohydrates chemically?
2. Into what main groups are they classified?
3. Into what classification should the following be placed: glycogen, lactose, corn syrup, cellulose, honey, cane sugar, dextrins, pectin, agar agar?
4. Approximately what percentage of the normal diet is furnished by carbohydrates?
5. What is an "enriched" flour or bread?

Suggested Projects

1. From your menus (your diet record of one week), list the carbohydrates you included Classify them according to the four main groupings set forth in this chapter Determine the percentage each group contributed to your total carbohydrate intake
2. From your menus, using the tables of food composition in the Appendix, calculate your average daily intake of carbohydrate Is it too high? Too low? Why? Can you change your dietary pattern so that your intake of carbohydrate will equal your needs?
3. What are the ten cheapest sources of carbohydrate on the market now? What is their relative cost?
4. Find an advertisement in which the carbohydrate of the product is mentioned Analyze the copy with respect to the information set forth in the previous discussion
5. Plan a low cost diet for one day that will provide an adequate 2,100 calorie diet What carbohydrates did you use?
6. If you needed to restrict your energy intake, which carbohydrate foods would you include? Which would you omit? Why?

CHAPTER 4

THE LIPIDS

Lipids are organic compounds which, for the most part, are synthesized by animals from plant sources Vegetable oils are usually found in the seed Because of the chemical composition and combination fats are a concentrated source of energy Outstanding fats found in the normal diet are butter, oleomargarine, cream some cheeses, meat fats, and salad dressings "Hidden fats" may be gravies avocados, and nuts Fats are an important constituent of the diet for both the energy and satiety value

The term "lipids" has been suggested by Bloor to include fats and other compounds which resemble them in physical properties Although members of this group have certain solubilities and properties in common for the most part they are diverse in their chemical constitution

The fats, the lipid with which this chapter is primarily concerned, are organic compounds of carbon hydrogen and oxygen, as are carbohydrates However, because fats contain less oxygen and more carbon than carbohydrates, fats are a more concentrated fuel and require more oxygen when it burns or oxidizes Consequently fats contribute two and one fourth times as many calories per given weight as do carbohydrates

Fat is stored in considerable amount in animal tissue (referred to as adipose tissue) where it serves as the reserve fuel supply in a fashion similar to carbohydrate storage by the plant To a lesser extent fat occurs in plants where it is usually stored in the germ portion The layers of fat may serve as a protection against mechanical injury Fat also acts as padding and support for the organs and as an insulation against rapid body temperature change In addition to "depots" of body fat, lipids are found in other areas of the body such as plasma lipids (phospholipids, cholesterol and cholesterol esters) and as constituent of cells While not so effective as carbohydrate in this role, fat has a protein sparing action

Bloor classifies the lipids as

1 **Simple lipids** Esters of fatty acids and alcohols
   a Fats, esters of fatty acid with glycerol. The familiar animal and vegetable fats belong to this group
   b Waxes, esters of fatty acids with an alcohol other than glycerol, for example, beeswax, wool wax, spermaceti, etc

2 **Compound lipids** Esters of fatty acids containing groups in addition to the fatty acid and alcohol radicals
   a Phospholipids, containing, in addition, phosphoric acid and nitrogen Lecithin a necessary constituent for cell life, belongs to this class It is found in egg yolk, milk, brain, bile, nerve tissue, and other animal tissues
   b Sterols, large molecular alcohols combined with fatty acids, as for example, cholesterol and ergosterol Cholesterol, one of the animal sterols, is widely distributed in nature It is a constituent of bile, being held there in solution by the bile salts Its presence in cells gives to them the property of holding water Ergosterol is a characteristic sterol of plant life When irradiated, it is known as calciferol which, when dissolved in oil, is commercially known as Viosterol or vitamin D_1

   Animal sterols can also be irradiated and when dissolved in oil are known commercially as Delesterol or vitamin D_3

   The compound lipids are known as lipoids They are fatlike substances but are more complex than the true fats—hence, are more reactive Active body tissue contains fat in this form

   Other groups are of lesser importance and need not be discussed here

As indicated above, the fats are simple esters of glycerol and fatty acids and are named according to this fatty acid molecule, as stearin from stearic acid and olein from oleic acid The hardness of any fat is determined by the fatty acid in combination with the glycerol Natural fats are mixtures rather than just pure fats so this hardness or consistency, which is related to the melting point of the fat, is not sharp The fats range in firmness from the oils to fats of extreme hardness It should be emphasized that the term "oil" in this instance refers to the physical state of a fat (meaning liquid fats) rather than its chemical nature (Chemically speaking, an oil may refer to the hydrocarbon oil derived from petroleum, such as mineral oil or lubricating oil)

Certain fats and oils (liquid fats) are unsaturated, that is they have double bonds capable of opening and receiving other radicals Such fats are soft in texture but may be hardened by the addition of hydrogen (a process known as hydrogenation)

The double bonds open and receive hydrogen ions and thereby become solid substances Advantage is taken of this process in the hydrogenation of cottonseed oil to form many popular shortenings

Fats so saturated do not become rancid as do fats in the unsaturated state a point of practical importance The rancidity of fats is due to a partial oxidation of the unsaturated groups hydrolytic changes and bacterial action Such changes decrease both the palatability and vitamin value The degree and speed of rancidity vary with individual fats

Recent experimental studies indicate that some unsaturated fatty acids are indispensable to good nutrition They are essential fatty acids and are either not synthesized or not synthesized rapidly enough in the animal body to permit their omission from the diet The exact function of the unsaturated essential fatty acids is not fully known but it has been suggested that they are needed as actual structural materials Some research has indicated that a deficiency of the essential fatty acids will result in skin lesions in the dog and the rat and as an eczema in man These essential fatty acids are linoleic acid (with two double bonds) linolenic acid (with three double bonds) and arachidonic acid (with four double bonds) They are present in such food fats as soybean whole wheat unhydrogenated cottonseed oil (Wesson) corn oil (Mazola) peanut linseed and olive oils and in egg yolk and to a lesser extent in lard Fats other than these essential fatty acids can be synthesized in the body from protein carbohydrate and other fatty acids Recent work suggests that the concept of need for the three essential fatty acids may change There is indication that linoleic may serve as a precursor of the other two

The characteristic flavor of food fats is due to foreign substances which are either absorbed from their natural environment or to substances which are produced during processing For example the bacterial flora of cheese and butter are carefully controlled so that the desired flavor is produced

Although fats are insoluble in water they can form satisfactory emulsion dispersions in water An emulsion is a suspension of one finely divided liquid in another one How permanent this suspension will be depends upon how finely the first liquid is broken up and second upon the presence of a third substance

which will prevent the fat globules from running together This substance is known as an emulsifying agent Soap, gum arabic, or protein itself (as found in milk and egg yolks) serves as an emulsifying agent

As the **digestion** of foodstuffs will be discussed later (Chapter 6), it is sufficient to point out that fats in an emulsified form, like egg yolk, cream, and milk, are more accessible to digestive enzymes than foods with the fat occurring in larger particles In addition, fats with low melting points are more readily digested than those with high melting points The fats are changed into their component parts, fatty acids and glycerol (glycerin), through the action of digestive juices (see Chapter 6) This splitting by hydrolysis is called **saponification**. If alkali is present at this time, it reacts with the free fatty acid to form salts or soaps

As indicated previously, fat in the diet fulfills four major **functions** (1) it serves as a source of energy as it is a concentrated form of fuel, (2) it adds flavor and zest to the diet, (3) fat foods because of their "stick to the ribs" value (which is discussed in Chapter 6) add satiety to the menu, and (4) fats are carriers of fat soluble vitamins and essential fatty acids

The chemical structure of fat, carbon hydrogen oxygen, indicates that it can be completely oxidized to carbon dioxide and water either in the body or in the bomb calorimeter In addition to its value in heat 9 3, or roughly 9 calories per gram, fat is important as a carrier of the fat soluble vitamins A, D, E, and K Animal fats are important sources of vitamins A and D, vegetable fats as sources of vitamins E and K (see Chapter 11) Thus the **fuel value** of all fats is approximately the same, even though the **nutritive value** may be different

The fat content of a meal influences its time in the stomach, and for this reason fat may be used to control hunger pangs A meal moderately high in fat has greater satiety value, it is more satisfying because it "stays by" longer than a meal low in, or devoid of fat This is a point to be remembered in planning certain diets

In appraising the long term trends (approximately forty years) of food consumption Dr Esther Phippard reported (1952) that there has been a steady but significant trend toward fewer calories However there has been a steady increase in the share

of the total calories derived from fat. The slight increase in grams of fat consumed per capita, coupled with the decrease in the total calorie intake, has resulted in a marked increase in the per cent of calories from fat, namely, from about 32 to 40%. Estimates of the **daily consumption** of fat range from 50 to 100 gm. It has been suggested that it is desirable to include from 25 to 40% of calories in the form of fat. This level is supplied by a range of 1 to 2 gm. per kilogram of body weight, or a total of 75 to 150 gm. of fat. Perhaps one of the factors bringing about the gradual increase of fat in the diet has been due to the emphasis upon protective foods, the leafy vegetables, in particular, which require salad dressings or butter, and the shift to higher priced foods such as eggs and meats which contain fats.

The foods rich in fat may be divided into two main groups, the animal and vegetable fats. Few foods contain solely fat and, for the most part, protein, some carbohydrate, and the fat-soluble vitamins are found in foods rich in fat. The **animal fats** include meat, fish, poultry, egg yolk, milk and milk products, and pure animal fats. To the latter group, the **vegetable fats**, belong the seed and vegetable oils in their natural state, when hydrogenated into lard substitutes, or when churned with milk to make margarines for butter substitutes.

A second grouping of fats is sometimes used. This is referred to as **"visible" and "invisible" or "hidden"** fats. The visible fats include such foods as butter, cream, lard, and salad dressings, while the hidden fats may be designated as the fats of meats, milk, cheeses, butter in cake and pastries, and eggs and nuts.

The **fat content of meats and fish** varies (see Chapter 5). Fat is stored in the cell walls of the connective tissues, around the internal organs, between the muscle fibers, and directly under the skin. The degree of hardness which is characteristic of each species is dependent upon the fatty acid content. There is *considerable variability in the fat content of the various commercial cuts of a meat*, such as beef or lamb. There is also a variability in the *fat content of various meats* as the percentage of fat is approximately 10% in a lean cut of pork to 80% in salt pork. Meat from which all visible fat has been removed still contains 6% fat.

In fish, the fat is deposited largely in the flesh. Usually a light or "white" flesh in fish indicates a low fat content, while a dark flesh suggests a high percentage of fat. Haddock and cod are always low in fat, while the fat content of most fish varies with the season. For the most part, fish store energy as fat in their livers instead of glycogen which is found in the livers of other animals. Such fish as tuna are frequently canned in oil which would supply additional fat.

The fat content of poultry varies considerably. Duck, goose, turkey, and fowl are higher in fat than the broilers. Breast meat of poultry is lower in fat than leg meat.

Meat, fish, and poultry contribute nutrients other than fat to the diet, primarily protein, the fat-soluble vitamins, some of the B complex, and several minerals.

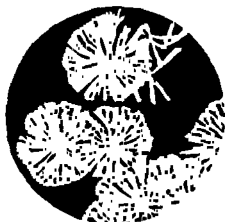


Fig 10.—Beef fat (From Hawk and Bergeim: Practical Physiological Chemistry, The Blakiston Co.)

Egg yolk contains approximately 30% fat in the form of an emulsion. Associated with these fats are other lipids (or fatlike substances), lecithin and cholesterol. The relationship of cholesterol to its metabolism in the body will be discussed in Chapter 39. Recent experiments indicate that the presence of lecithin stimulates the rate of absorption and the extent of digestibility of fats. It has been suggested that this is due to its emulsifying action, in which case it is logical to expect enhancement due to homogenization of milk. Mineral salts, iron, and the fat-soluble vitamins A and D plus thiamine and riboflavin are also present in egg.

Although milk contains only 4% fat, a considerable amount of fat in the diet comes from milk and milk products

Cream is the concentrated fat of milk It is removed from the milk by various methods of separation, usually by centrifugal force The degree of separation is expressed as percentage in commercially marketed cream—20, 30, and 40% cream The terms 2, 3, or 4 X—light or coffee, medium, and whipping cream, are also used By means of a separator it is possible to concentrate the fat to 60%, and, by churning, to 85% (butter) In addition to fat, cream contributes vitamin A to the diet

Butter is prepared by churning cream, a process which results in the coalescence of the fat globules Butter is actually concentrated cream, and contains 85% fat It may be prepared from either sweet or sour cream, and is marketed in salted and unsalted forms Salted butter made from sour cream is the more common form Butter is also rich in vitamin A value

Cheese supplies appreciable amounts of fat, depending upon the type of basic milk "True" cottage cheese, a skim milk product, contains only 1% fat However, many commercial concerns add cream to cottage cheese to increase its acceptability Full cream cheese cheddar or Swiss cheese may contain as high as 35% fat

Lard, suet, and tallow are the fats of pork, beef, and mutton Rendered free from connective tissues, they may be prepared as pure fat

As indicated previously, vegetable fats are the second large group which contribute fat to the diet These fats may be used in either a liquid or solid form Many oils that are obtained from seeds, such as cottonseed or from corn, are used in salad dressings Olive oil, which is pressed from the fruit of the olive tree, is an expensive yet popular constituent of salad dressings

Hydrogenated fats, which were discussed previously, are usually made from the oils of cottonseed, corn, soybean, and peanut These are primarily used in pastries cakes, and as a fat in frying

Other vegetable foods which are relatively high in fat content are chocolate and cocoa As fruits, avocados and olives contribute fat to the diet

Nuts are rich sources of fat and protein and, except for chestnuts, are poor sources of carbohydrate Nuts are good sources

TABLE 6

COMPARATIVE AMOUNT OF FAT IN SOME COMMON FOODS

FOOD	PROTEIN %	FAT %	TOTAL CARBOHYDRATE %	ASH %	WATER %	CALORIES (100 GM PORTION)
Butter	0.6	81.0	0.4	2.5	15.5	716
Margarine	0.6	81.0	0.4	2.5	15.5	720
Lard	0	100.0	0	0	0	902
Peanut butter	26.1	47.8	21.0	3.4	1.7	576
Walnut	15.0	64.4	15.6	1.7	3.3	654
Olive oil	0	100.0	0	0	0	884
Mayonnaise	1.5	78.0	3.0	1.5	16.0	703
French dressing	0.6	35.5	20.3	4.0	39.6	394
Cream (light)	2.9	20.0	4.0	0.6	72.5	204
Bacon (broiled)	25.0	55.0	1.0	6.0	13.0	607
Hydrogenated fats	0	100.0	0	0	0	884

Adapted from U. S. Department of Agriculture Handbook No. 8, Composition of Foods—Raw, Processed, Prepared.

of copper, iron, and manganese, and contain B vitamins. Peanuts contain 50% fat and 30% protein, Brazil nuts, 65% fat and 23% protein, and pecans, 73% fat and 9% protein. The water content of nuts is low.

Although margarine manufacture in this country had its beginning about 1875, the scarcity of butter during World War II led to an increased use of margarine as a spread, in seasoning, and in baking. Now it is a large industry. At first, margarine was made from animal fats, chiefly oleo oil from beef suet, but now vegetable oils, primarily cottonseed and soybean oils, are used almost exclusively. The oils are hydrogenated, mixed with pasteurized and cultured skim milk until an emulsion of milk in oil (which is margarine) is obtained. It is then salted and packaged. Most margarines are fortified with vitamin A and some have vitamin D added. In addition, many brands have been colored and are packaged to resemble butter.

One brand of margarine lists its composition as shown in Table 7.

Usually fats are unaffected by *cooking* procedures such as baking, steaming and boiling. However, in frying, the cooking of food in hot fat, the temperature is of utmost importance. The improper heating of fats may result in a thin, bluish white smoke rising from the surface. The temperature at which this occurs is called the smoking point of the fat. This indicates that a decomposition is taking place producing substances among which

TABLE 7

INGREDIENT	PERCENTAGE	WHY USED
American cottonseed oil	80 0	An excellent energy food
Cultured skim milk	16 5	The fresh pasteurized and cultured skim milk which helps give it a delicate appetizing flavor
Salt	2 8	To impart the proper seasoning
Derivative of glycerine	0 5	This product helps make it practically nonspattering when used in pan frying
Vegetable lecithin	0 1	Reduces "sticking to the pan" in pan frying
Benzoate of soda	0 1	A preservative Helps retain its fine fresh flavor
Vitamin A—15,000 units U S P per pound		To make it a reliable year round source of this important vitamin
Diacetyl		An artificial flavor Enhances the flavor and aroma

are fatty acids and glycerol If the temperature is allowed to increase, a substance called acrolein is formed from the glycerol Acrolein is acrid in odor and irritating to the eyes If food has been cooked in overheated fat it may be irritating to the gastro intestinal tract as well

Smoking point temperatures i e the point at which decom position takes place vary For example the cottonseed and corn oils break down at 222° to 232° C , the hydrogenated fats at essentially the same level 219° to 232° Lard undergoes change at a lower level 214° to 221° and if the lard has been reused a number of times at even a lower temperature of 190° The value for butter is given as 208° for olive oil 167° to 175°, and for peanut oil 150° to 160° Cooking charts which are care fully worked out as to temperature should be followed

Review Questions

1 What is the difference between the terms "fats" and "lipids"?
2 What are fats chemically?
3 How are fats classified?
4 What is meant by an unsaturated fat?
5 What are the "essential fatty acids"? Why are they so named?
6 What is the caloric value of fat per gram?
7 In addition to its energy value why is fat an important constituent of the dietary?
8 Are margarines satisfactory substitutes for butter?
9 What percentage of the dietary should be provided by fat?
10 What are the important sources of fat in the dietary?
11 Differentiate between hidden fats and visible fats

Suggested Projects

1 From your menus (your diet record of one week) list the fats you included Classify them according to the main groupings set forth in this chapter Determine the percentage each group contributed to your total fat intake

2 From your menus, using the table of food composition in the Appendix, calculate your average daily intake of fat Is it too high? Too low? Why? Can you change your dietary pattern so that your intake of fat will equal your needs?

3 What hidden fats did you include in your diet? What per cent of the total fat intake do they represent?

4 What are the ten cheapest sources of fats on the market now? What is their relative cost?

5 If you needed to restrict your energy intake, which fats would you include? Why? Which would you omit? Why?

6 List your favorite foods How many are rich in fat content?

CHAPTER 5

THE PROTEINS

> Protein, one of the most important of the nutrients, nourishes the body in three ways: as a source of energy, as material for growth and upkeep, and as a regulator of body processes. Proteins are important in relation to their constituent amino acids. Some of these amino acids are classified as "essential," as they cannot be synthesized by the body. Meats, vegetables, legumes, milk and milk products all provide amino acids. Current research is directed toward the sources and amounts of specific amino acids.

One of the most important of the foodstuffs necessary for the maintenance of life is protein. The word has a Greek derivation and means to come first. *Protein* is usually the first nutrient considered since every living cell contains and must have a continuous supply of protein if its life is to be maintained. Protein forms a large part of the solid matter of animal tissue (15 to 20%). In the plant kingdom, while protein occurs less abundantly than does carbohydrate, it still is an important constituent. In fact, it is the plant which supplies the original source of the animal protein. The plant in some manner peculiar to itself combines carbohydrates (which it synthesizes from carbon dioxide and water under the influence of sunlight) with ammonia or nitrogenous compounds in the soil to form protein. While animals can rebuild protein in their tissues, they cannot produce it from simple inorganic innate substances which have never lived. Through the ingestion of vegetable proteins animal tissues are formed. Roughly 10 pounds of vegetable protein are required for the construction of 1 pound of animal protein. Through the ingestion of animal and vegetable proteins man is able to build his body structure. While protein, as can be seen from its constituents, serves as a source of energy, its chief function is to supply the tissue building material.

Chemically, protein is a complex organic substance containing carbon, hydrogen, nitrogen, oxygen and sulfur. Some proteins also contain phosphorus and other elements. As indicated in

Chapter 2, during the process of digestion, protein is broken down into its structural units, the amino acids These amino acids are carried in the blood stream to all parts of the body The individual body cells are thus enabled to pick from this supply the particular amino acids necessary for *growth, repair*, formation of new tissue, including enzymes, hormones, hemoglobin, antibodies The process may be likened to the building up of various words by selection and combinations of the individual letters of the alphabet A molecule of protein may combine as many as several hundred individual *amino* acids Countless combinations are possible The amino acids not immediately utilized for structural purposes or to a slight extent stored as reserve protein are broken down and used as energy

Certain of these **amino acids** must be supplied preformed to the body by *way of the ingested food The others can be synthe*sized one from another within the body itself They are accordingly divided into two groups **essential** (occasionally called indispensable) and **nonessential** (often referred to as dispensable) Obviously all amino acids (about 25 are known to exist) are essential, however, those differentiated as essential are unable to be synthesized by the body itself

Table 8 lists the two major groups of amino acids A few which are not considered of primary importance (1953) are not included

TABLE 8

ESSENTIAL	NONESSENTIAL
(Arginine)	Alanine
(Histidine)	Aspartic acid
Isoleucine	Citrulline
Leucine	Cysteine
Lycine	Cystine
Methionine	Glutamic acid
Phenylalanine	Glycine
Threonine	Proline
Tryptophane	Hydroxyproline
Valine	Serine
	Tyrosine

Those in parentheses indicate that they are believed essential for growth but not for maintenance in the adult man

We used to be concerned with the total protein intake, but now it is evident that it is the amino acids that are the essential nutrients, not the *proteins alone*

Proteins may be classified according to their composition and physical characteristics

1 Simple proteins yield amino acids or their derivatives upon hydrolysis Simple proteins may be subdivided into a number of groups but only two groups need mentioning here the albumins to which belong egg albumin and serum albumin (blood), leucosin of wheat, legumelin of peas, and the globulins, examples of which include serum globulin muscle globulin, edestin of wheat and legumin of beans and peas

2 Conjugated proteins are substances which contain the protein molecule united to some other molecule Examples are the nucleoproteins found in thymus gland and wheat germ which contain nucleic acid, the glycoproteins containing carbohydrate (the mucins), the phosphoproteins containing phosphorus—caseinogen (milk), ovovitellin (egg yolk) and the hemoglobins which contain hematin—for example, the hemoglobin of blood

3 Derived proteins are products resulting from partial hydrolysis They include proteans metaproteins coagulated proteins, proteoses peptones and peptides

Primarily, the protein needs and specifically the amino acid needs, have been measured in two ways one by *animal experiments* which evaluated growth and two through studies which measured the nitrogen balance of subjects Recent research has suggested the possibility of determining the amino acid content of the blood and urine

As early as 1897 Rubner indicated that all proteins were not of equal value The reason as we now know, is the variation in amino acid content However Thomas B Osborne, who was at the Connecticut Agricultural Experiment Station in New Haven, and Lafayette B Mendel of Yale, through their painstaking well known experiments established the fact that "*certain amino acids cannot be synthesized by living cells out of materials ordinarily present and consequently must be supplied in a preformed state*" This information was published in 1914 The data were obtained from animal feeding experiments which were evaluated by the rate of growth of the animal

For example Osborne and Mendel showed that if rats were given casein (protein of milk) as the only protein in an otherwise adequate diet they grew satisfactorily If the casein was replaced by gliadin (one of the proteins of wheat), the animals were able to maintain their weight but did not grow When zein, one of the proteins of corn, replaced the casein, the animals

lost weight and died. Zein lacks the amino acids, lysine and tryptophane. Gliadin contains but small amounts of lysine.

Experiments continued through the years. W. C. Rose and his associates at Illinois announced that ten amino acids were found to be essential dietary components for the growing rat. Although arginine can be synthesized by the rat, this cannot be accomplished at a rate commensurate with the needs of the organism for maximum growth.

A second approach to protein metabolism in the body has been to measure the *nitrogen of the urine.* When the nitrogen eliminated is exactly equal to the nitrogen of the diet (protein is approximately 16% nitrogen), nitrogen equilibrium (or nitrogen balance) is said to exist. If outgo exceeds intake, a loss of body protein is indicated, and the balance is negative. Such a condition exists when the metabolism is elevated in fevers or toxic states. If intake exceeds outgo, there is storage of protein, and the balance is then positive. This occurs during periods of growth such as infancy, childhood, or adolescence, pregnancy or lactation, and recovery from a malnourished state or a healing process. The normal maintenance diet should be such that nitrogen equilibrium is possible. The protein level at which nitrogen equilibrium can be established is dependent upon the carbohydrate level of the diet and the total caloric intake.

W. C. Rose conducted a ten-year investigation, using male graduate students as subjects, to establish the amino acid requirements of *human subjects.* He found that there were eight amino acids essential to adult maintenance of nitrogen equilibrium. *These are the amino acids listed as essential in* Table 8. Arginine and histidine were found nonessential (although necessary for growth in the rat) and were therefore placed in parentheses.

Since Rose had established the qualitative amino acid requirements of man, he set out to determine the smallest amount of each of the eight essentials which would suffice to maintain nitrogen equilibrium. In 1949 Dr. Rose published the results of his five years' investigation as minimum requirements of essential amino acids. In addition, to provide for the chance that some individuals might require even more of the amino acids than those actually observed by Rose, he suggested "recommended

daily intake" which was twice the amount found as a requirement These suggestions of Dr Rose's are summarized in Table 9 These recommendations are based on the assumption that an adequate amount of additional protein will be ingested so that synthesis of nonessential amino acids will take place

TABLE 9

ESSENTIAL AMINO ACID NEEDS OF MAN*
MINIMUM AND SAFE INTAKES FOR NORMAL MAN
WHEN THE DIET FURNISHES SUFFICIENT NITROGEN FOR THE SYNTHESIS OF THE NONESSENTIALS

AMINO ACID	MINIMUM DAILY REQUIREMENT (GM)	SAFE DAILY INTAKE (GM)	NUMBER OF SUBJECTS TESTED
L-Tryptophan	0 [illegible]	0 5	37
L Phenylalanine	1 10	2 2	28
L Lysine	0 80	1 6	33
L-Threonine	0 50	1 0	24
L Valine	0 80	1 6	29
L Methionine	1 10	2 2	19
L-Leucine	1 10	2 [illegible]	14
L Isoleucine	0 70	1 4	14

*Rose W C Chem & Engineer News 30 2385 1952

Recently, Albanese reported on his experiments concerning the amino acid needs of male *infants* He found that all ten of the so called essential amino acids were necessary for growth in the human infant In addition as a result of his investigations he suggested minimum and recommended amounts of each amino acid He also revealed that evidence had been presented which supported the concept that certain amino acid deficiencies in man can be identified by changes in amino acid levels in the urine or the blood

What then are the *sources of these essential and nonessential amino acids?* In order to clarify the differences between individual protein foods the following classification has sometimes been used

1 Complete protein is one which will maintain life and support growth when used as the sole source of protein food These foods are also spoken of as adequate Class A protein or a *protein of high biological value* Animal proteins such as milk eggs cheese meat and fish have ' high biological value They are complete proteins and thereby contain all of the essential amino acids Gelatin is the exception it is not a complete protein for it lacks three essential amino acids—valine tryptophane and isoleucine

2 "Partially incomplete protein" is one which maintains life but does not support normal growth These proteins are often called inadequate, or a Class B protein They contain many amino acids but not all of the essential ones The cereal and vegetable proteins have a lower biological value, i e, they lack some of the important amino acids and alone they cannot support growth, hence, they are called partially incomplete proteins Vegetable proteins such as the legumes (beans peas lentils, and peanuts), are sometimes called 'poor man's meat," because the protein of these foods can satisfactorily supplement the animal group By the inclusion of these proteins in the diet, the animal proteins (always more costly in dollars and cents) may be decreased in amount

3 "Incomplete proteins" are incapable either of maintaining life or of supporting growth when used as the only protein The most striking examples of this group are zein of corn and gelatin

These classifications are not inflexible, for a food may contain all of the essential amino acids and still have low biological value If some of the essential acids are present in small amounts, obviously large quantities of the food must be consumed in order to assure adequacy Such a food is excellent to supplement other proteins but not practicable as the only one Soybeans belong to this class

The value of *supplementation* has long been recognized However, only recently has the importance of the time factor in ingesting amino acids been realized *For protein synthesis, it has been found that all the essential components have to be present simultaneously* As was indicated previously, amino acids that are not used for structural growth are irreversibly metabolized and are therefore not available for synthesis It is known, for example, that the protein of milk supplements the protein of wheat, and to secure maximum effectiveness they must be taken together Thus additional information on the amino acid content of food will result in the ability to supplement proteins combine them or enrich them in such a manner that the essential amino acid content is made adequate This will bring about a lowering of the cost of protein food

The thought behind the Cornell formula and possible lysine fortification is the inability of cereal products alone to be completely adequate for optimum growth due to the deficiency in certain amino acids In wheat it is the amino acid lysine which is so limited *in amount that the cereal protein can serve as complete protein only* to the extent of 50% Milk contains an abun

dance of lysine The right combination of milk and wheat results in enough lysine to make both proteins complete Since enough milk to accomplish this is not feasible in bread the soybean and wheat germ are added The wheat germ is a restoration of the milled flour to whole wheat status

To these who eat but three or four slices a day the improvement in "bread" is not significant To those who are heavy bread eaters i e eight to ten slices a day—especially when the budget necessarily restricts the animal proteins—this added enrichment is of definite economic value If a better food can be obtained be equally palatable and at essentially no additional cost it seems sensible to get the most for the money spent

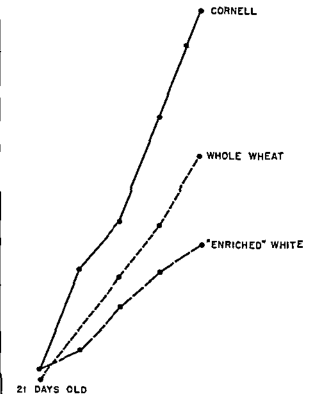


Fig 11 —The upper photograph shows the effect of a dietary deficiency of the amino acid valine The lower photograph shows the same animal after valine had been administered for twenty five days (From Rose and Epstein J Biol Chem 1[illegible] 683 1939)

From this type of bread improvement it is possible to go on to the improvement of other cereal products and so reduce the cost but not the quality of our protein foods—or to make more good protein available

Figs 12 and 1[illegible] indicate the effect on growth of animals fed on only enriched white bread and the Cornell formula bread in the same quantitative amounts The improvement is obvious

The amino acid content of some food has been determined (See Table 10) Perhaps it soon will be possible to chart the



Figs 12 and 13—Show the difference in growth response of rats fed enriched white bread, 100% whole wheat bread and bread made from the Cornell formula In size and appearance the whole wheat bread is between the 'Cornell' and the enriched white The growth and appearance of the Cornell fed rat are essentially that of a control rat fed standard rat chow. The smallest rat not only is smaller but patches of hair loss can be noted on the back at the hind legs The th

amino acids as we do the vitamins and minerals indicating need deficiency signs and sources

In the **breakdown of protein in the body** certain amino acids are found to be capable of yielding glucose (a simple sugar) and *others of yielding a fatty acid* *This fact is of importance in the* diet planning for those conditions in which carbohydrate metabolism is impaired since this glucose is treated by the body in the same manner as ingested glucose On the average 50% of the protein by weight may be considered to be potential sugar and 50% to be potential fatty acid (58% glucose and 46% fatty acid to be exact the total of 104% is due to the overlapping of certain amino acids) If adequate protein is not present in the diet one tissue may be called upon to supply repair material for a more important one Such a shift takes place in starvation wasting diseases and sometimes when high fever is present

It is possible to decrease protein oxidation for energy purposes by inclusion of an abundance of carbohydrate hence one speaks of the **sparing action of carbohydrate** Protein is much more efficiently used in the presence of abundant carbohydrate than in the presence of abundant fat Carbohydrate therefore is a more effective protein sparer than fat

The **protein requirement** has been a controversial matter for some years There have been those who advocated very low protein intake on the premise that large intake increases the work thrown on the kidneys (the excretion of urea and ammonia as well as the acids resulting from the mineral content of the protein) There have also been those who advocated high intake of protein Today the consensus is that a middle course is preferable

When protein supplies approximately 10% of the required calories the gram amount is essentially that recommended by the National Research Council for usual activities

$$10\% \text{ of } 3\,000 \text{ calories} = \frac{300 \text{ protein calories}}{4 \text{ calories/gm}} = \begin{matrix}75 \text{ gm protein or} \\ 1 \text{ gm/kg body weight}\end{matrix}$$

Inasmuch as protein metabolism *is not increased by activity* when *excessively* hard work is carried on the protein is not equal to 10% of the calories

However, when the high caloric intake is due to metabolic activity as in the late teen age boy, it will be seen that 100 gm. of protein again represents 10% of his caloric need.

If the diet contains a full quart of milk, extra egg, meat, or cheese, as is so frequently the case when the budget permits this expenditure, the percentage of protein calories rises to around 15%.

When the protein allowances for children are calculated according to their greater need in relation to their size, it will be found that the protein level suggested as optimum is not far from 15% of their caloric need. The formula for the infant carries out this relationship. (See discussion in Chapter 19.)

Then, for a *rough* estimation of optimum protein intake the range of 10 to 15% may be used. It is an easily remembered range when exact figures are not available and when calculated back to the suggested intake on a basis of kilograms of body weight, it will be found to correlate satisfactorily.

TABLE 11

RECOMMENDED DAILY DIETARY ALLOWANCES FOR PROTEIN

Food and Nutrition Board, National Research Council, Revised 1953

	AGE (YR.)	WEIGHT KG	(LB.)	HEIGHT CM	(IN.)	PROTEIN GM
Men	25	65	(143)	170	(67)	65
	45	65	(143)	170	(67)	65
	65	65	(143)	170	(67)	65
Women	25	55	(121)	157	(62)	55
	45	55	(121)	157	(62)	55
	65	55	(121)	157	(62)	55
	Pregnant (3rd trimester)					80
	Lactating (850 ml. daily)					100
Infants	0–1/12*					
	1/12–3/12	6	(13)	60	(24)	kg. × 3.5
	4/12–9/12	9	(20)	70	(28)	kg. × 3.5
	10/12–1	10	(22)	75	(30)	kg. × 3.5
Children	1–3	12	(27)	87	(34)	40
	4–6	18	(40)	109	(43)	50
	7–9	27	(59)	129	(51)	60
Boys	10–12	35	(78)	144	(57)	70
	13–15	49	(108)	163	(64)	85
	16–20	63	(139)	175	(69)	100
Girls	10–12	36	(79)	144	(57)	70
	13–15	49	(108)	160	(63)	80
	16–20	54	(120)	162	(64)	75

*See Table 3 for explanatory footnote.

Such percentage will supply about 3.5 gm. of protein per kilogram of body weight in the infant. During those early years, 3.5 gm. per kilogram is usually ingested; later as the first rapid growth diminishes (at 5 to 7 years), the protein may be dropped to 2 gm. per kilogram until after puberty. Throughout adult life the protein can be decreased to 1 gm. It should never be allowed to drop below this level unless therapeutically imperative. The recommendations of the National Research Council for protein intake for specific age groups are found in Table 11.

As indicated in Chapter 2, the body proteins are continuously undergoing synthesis and breakdown. They are not static tissues; *resynthesis occurs even in the starved animal.* This new idea is contrary to the older theory which postulates little or no change in the tissues once they are formed. The breakdown and rebuilding are normally in such balance that total body protein remains essentially unchanged. Experiments on rats indicate that half of the body proteins will undergo such change in a week's time.

With the *higher levels* of 1 gm. or more per *kilogram*, proteins of lower biological value may supplement the animal group. The general dietetic practice of obtaining half of the protein from animal and half from vegetable sources results in a satisfactory balance of amino acids and is both economical and palatable.

Since protein is approximately 16% nitrogen, the amount of protein metabolized can be calculated by multiplying the nitrogen in the urine by the factor 6.25 (100 ÷ 16%). In fact, the protein content of food is determined by multiplying the nitrogen value, as ascertained chemically, by this factor.

Protein Foods

As has been pointed out, an adequate amount of protein is essential for normal growth and development, and approximately one-half of the protein must be of high biological value. Knowledge of the protein foods available is essential if one is to meet this requirement intelligently. While almost all foods contain some protein, foods are classed as protein foods only when the amount of protein is sufficient to be of definite value when the

ood is ingested in normal amounts The chief sources of protein are milk, milk products, meat, fish, eggs, legumes, cereals, and some vegetables

Milk, the first protein food which comes to mind, is of great importance throughout life Its routine inclusion in the daily diet in keeping with the suggestions of the Basic Seven, 1 pint per day for adults to ¾ or 1 quart per day for the growing child and 1 quart in pregnancy, is protection against deficiencies of protein, calcium, phosphorus, and vitamins A and B_2 (or riboflavin)

The **composition of milk** varies slightly with the breed of cow, season of the year, and feeding schedule, but the average composition is 86% water, 3 3% protein, 4% fat, 5% carbohydrate, and 0 7% minerals Its **caloric value** is approximately 670 calories a quart The specific nutritive value of a quart is indicated in Table 12

TABLE 12

NUTRITIVE VALUE OF 1 QUART OF MILK*

Recommended Dietary Allowances (Revised, 1953) of 25 year old Reference Woman

ELEMENT	AMOUNT FOUND IN 1 QUART MILK	RECOMMENDED DIETARY ALLOWANCE OF 25 YEAR OLD REFERENCE WOMAN
Calories	666	2,300
Protein	34 2 gm	55 gm
Fat	38 1 gm	
Carbohydrate	47 8 gm	
Calcium	1 15 gm	0 8 gm
Phosphorus	908 mg	
Iron	0 7 mg	12 mg
Vitamin A	(1,550) International Units	5,000
Thiamine	0 35 mg	1 2 mg
Riboflavin	1 68 mg	1 4 mg
Niacin	1 1 mg	12 mg
Ascorbic acid	13 mg	70 mg
Vitamin D	(May be fortified)	
Also contains small amounts of		
Magnesium		
Potassium		
Sodium		
Chlorine		
Copper		
Manganese		

*From U S Department of Agriculture Handbook No 8 Composition of Foods Raw Processed Prepared

The proteins of milk are three casein (2 7%) lactalbumin and lactoglobulin (the latter two together form 0 5% see Proteins classification) The carbohydrate is in the form of lactose (milk sugar) The fat is a mixture of the glycerides of palmitic oleic *myristic and butyric acids The first two glycerides* occur in greatest amounts The fat is emulsified in the form of very fine droplets which increase the ease of its digestion The important minerals of milk are calcium phosphorus and potassium and riboflavin is one of its important contributions The major deficiency of milk is its low iron content The iron present is however in readily available form The lack of iron is compensated for in early life by the extra iron stores in the liver of the newborn infant

As the result of pasteurization the vitamin C (ascorbic acid) content of milk is lowered to around 1 mg per 100 gm or roughly to one half that of the raw milk Fortunately it is not necessary to depend on milk as a source of vitamin C

Since milk forms such an important item in the diet and since it provides an excellent medium for the rapid multiplication of harmful bacteria (see discussion of undulant fever) it is marketed under strict *sanitary control and inspection* It is graded according to bacteriological standards into certified grade A and grade B Fluid milk may be sold in many forms certified raw or pasteurized pasteurized whole milk homogenized and fortified milk Other fluid milks which have been modified to some extent are skim milk buttermilk various commercial milks and yogurt In addition there are many milk products such as evaporated milk powdered milk and cheeses

Certified milk may be sold in the raw state other grades of milk must be pasteurized Its certification means that the conditions under which it was produced and distributed conform with the high standards for cleanliness set forth by the American Association of Medical Milk Commissions The State Board of Health supervises the production and distribution of certified milk as well as that of other milks As indicated certified milk may be sold either raw or pasteurized The possibility exists however that between periods of inspection infection may develop in a herd

By *pasteurization* is meant the heating of milk to destroy disease producing organisms and usually 99% of all the bacteria

which may be found in milk Two methods are used In the first, the milk is heated to at least 143° F and held at that temperature for not less than 30 minutes This is the usual method and is often referred to as the "hold" method The second way, milk is heated to at least 160° F for not less than 15 seconds and then it is promptly cooled to 50° F or lower This is done in approved and properly operated equipment By pasteurization, the milk is not only made safe, but its keeping quality is improved The food value is not changed significantly, although, as indicated previously, some thiamine and ascorbic acid are lost

Pasteurized milk is usually sold as whole milk, however, many prefer homogenized and irradiated or fortified milk *Homogenized milk* is whole milk which has been forced under high pressure through fine apertures with a resulting decrease in the size of the fat globules This marked decrease in the fat droplet size alters the quality of the milk No longer will the cream rise to the surface when the milk is allowed to stand, the mixture is homogeneous throughout The curd size is smaller and somewhat more easily digested There is a slight alteration in flavor The food value of milk is unchanged by the homogenization process

Fortified milks are those containing added amounts of one or more of the essential nutrients normally present in milk The Council on Foods and Nutrition of the American Medical Association recognized the fortification of whole milk with vitamin D a fact of public health significance Vitamin D milk must contain 400 U S P units of vitamin D per quart to meet the requirements for acceptance by the Council This is usually added in the form of a concentrate

Other milks which are sold widely are modified to some extent This is especially true of skim milk Skimmed milk may be defined as milk from which a sufficient proportion of fat has been removed to reduce its milk fat content to less than 3 25% Usually, however, the available fat in skim milk is less than 0 1% Nonfat milk solids, from 0 5 to 1 5%, have been added to some skim milks By removing the fat from milk, the vitamin A content is also removed Other nutrients remain essentially unchanged and, when nonfat dry milk solids are added, the values are enhanced Occasionally skim milk is fortified with a vitamin

A and a vitamin D concentrate, this usually contains 2,000 International Units of vitamin A and 400 U S P units of vitamin D per quart

Buttermilk is usually the by product of the churning of sour cream into butter There is also sweet cream buttermilk which is, in turn, the by product of the churning of sweet cream in the preparation of sweet cream butter Buttermilk may also be cultured This is usually accomplished by the addition of the bacteria *Streptococcus lactis* to either skim or whole milk until the acidity is 0 8 to 0 9% The butter fat content of these milks ranges from 0 1 to 1 5%

Various commercial milk products are available, protein milk, lactic acid milk, hypoallergic milks low sodium, and others These have their places in therapeutic diets, but space does not permit a discussion of them here

Excess fluid milk, or milk produced in sections well adapt to dairying, but far removed from immediate consumers, is pr served for future use by evaporation into three different pro ucts *Evaporated milk* is milk concentrated to approximate one half its original volume No sugar is added, but it is su jected to much drastic heat treatment (more so than condens milk) The water is removed by heating the milk at 120° to 14 F in vacuum pans After evaporation, the milk is homogenize cooled, placed in cans and sterilized (240° F for 15 minutes Now most of the evaporated milk is fortified with vitamin D

Condensed milk has sugar added to it in the amount of pounds to 100 pounds of milk before the process of evaporati is begun The finished product contains about 54% sucrose Th sugar acts as a preservative so the milk, when it has been seal in cans can be stored without further heat treatment

Several processes have been invented for the reduction of mi to *powdered* form Dried milk is made from whole milk ar nonfat dry milk solids are made from skim milk The milk preheated at 140 to 180° F for 20 to 30 minutes and then it concentrated in vacuum pans The milk is dried by sprayir into a chamber of hot air or onto a slowly revolving heated dru under vacumm From 95 to 98% of the water is removed b this process Nonfat dry milk solids may be stored for lon periods of time in moisture proof bags drums, or cans at ord nary room temperatures Dried whole milk is usually pac

aged in vacuum cans and can be stored at room temperature until opened After opening they must be refrigerated as the fat may become rancid

As a result of these processes the composition of milk becomes

	% P	% F	% C	% Ash	% H_2O
Evaporated	9.6	9.3	11.2	1.7	68.2
Condensed (sweetened)	8.8	8.3	51.1	1.9	26.9
Powdered or dried	26.7	28.0	38.0	5.8	1.5

TABLE 13

COMPARATIVE COST FOR 1 OUNCE (30 GM) PROTEIN
(Prices of August, 1954)

FOOD	AMOUNT CONTAINING 30 GM PROTEIN	COST
Steak (round)	4 oz	19¢
Lamb chop (rib with bone)	8 oz	43¢
Beef stew meat (chuck)	4 oz	14¢
Beef liver	4 oz	6⅙¢
Fish (haddock)	5⅙ oz	21¢
Cheddar cheese	4 oz	18¢
Egg (medium)	5 (each)	27½¢
Whole milk (homogenized)	26 fl oz	21¢
Skim milk	25 fl oz	16¢
Nonfat dry milk solids	11 T	6¢
Bread (white)	12 oz (approximately)	12¢
Oatmeal (dry)	2¾ cup	20¢

Milk is an economical food at any unit cost that may prevail Table 13 illustrates this economy by a comparison of the cost of 1 oz (30 gm) of protein from several sources No other single food contributes so much in nutriment Table 12 indicates its nutritive value

In the book *Your Meals and Your Money* Gove Hambidge writes ' Perhaps no single thing would bring about a greater improvement in the American dietary as a whole than a liberal use of milk and milk products

Where whole milk seems costly nonfat dry milk solids and evaporated milk can make satisfactory substitutes When skim milk is used the decrease in calories due to fat subtraction and the loss of the fat soluble vitamin A must be considered

Cheese is the clotted portion of milk and has therefore a high protein content Left behind after the removal of the curd is a milky liquid known as whey This has the composition water 83%, protein 1% fat 0.3% carbohydrate 0.5%, and min

erals 0.7%. It contains lactalbumin, soluble salts, water soluble vitamins, and sugar. Cheese is of two main classes, hard and soft. The manufacture of cheese was probably originally a means of preservation of milk, but today cheese forms an important part of the diet. It ranks first from the standpoint of amount of protein. No other food contains more per unit of weight. For example, an American cheese (hard) gave an analysis of water 27%, protein 28%, carbohydrate 4%, and minerals 4%. Meats and fish vary from 13 to 25% protein, beans 22%, cereals 8 to 12%, and fruits and vegetables 1 to 3%. One pound of cheese is equivalent to approximately 1 gallon of milk in protein value. Cheese is marketed as skim milk cheese, cream cheese, or full cream cheese, depending upon the fat content.

Eggs. Milk and eggs are sometimes spoken of as perfect foods because they alone adequately support growth or development of the young. Egg contains approximately 74% water, 14.5% protein, 10.5% fat, and 1% minerals. The white contains albumin, globulin, glycoproteins, and ovalbumin. The yolk contains albumin, nucleo albumin as vitellin and lecithin, phosphorus, calcium, sulfur, potassium, and iron. The fat is admixed with the protein in the egg yolk to form an emulsion (see Chapter 4). Egg yolk is also a carrier of vitamins A, thiamine, riboflavin, and D. The Basic Seven recommends one egg a day, and at least four a week.

Meat

All meat has essentially the same physical structure, nutritive value, and digestibility. As the term is usually used, it includes poultry and fish.

Meat or muscle tissue is composed of bundles of tiny fibers embedded in and held together by white fibrous connective tissue. The length of these bundles and the extent of the connective tissue largely determine the tenderness of the meat. In the young animal with unused muscles, the fibers and connective tissue are tender, but as he grows older and exercises more, they become increasingly tougher. Imbedded with the fibers of the connective tissue is a fat characteristic of the animal. This varies in amount, but even the leanest meat has some fat.

Meat is 13 to 25% protein, uncooked weight (25 to 30% after cooking), 10 to 15% fat, 50 to 60% water, and 1% ash. Meat

is an excellent source of the B vitamins, including niacin which is present only in traces in dairy products and eggs, and of phosphorus, potassium, and sulfur. Its caloric value varies with the fat content from 25 to 100 calories per ounce, averaging 60 calories.

Meats owe their flavors largely to the extractives which are present. These extractives have a stimulating effect on the flow of gastric juice. Meats are almost completely digested with ease (96 to 98%). Contrary to the often expressed theory, this does not mean that meat is a constipating food, even though it leaves little residue.

The idea that a difference exists between light and dark meats, or light meats and red meats, is also prevalent. Dark meats do have slightly longer fibers and red meats a higher extractive content, but, in general, the *digestibility and composition are sufficiently equal to make discrimination unnecessary*.

The edible glandular meats fortunately are now coming into common usage. Our early ancestors considered the entrails of animals a luxury. Uncivilized tribes still do. As a result they have at hand means of preventing dietary errors. The edible glandular meats, liver, kidney, and heart, are excellent foods as current research indicates.

Liver comes nearer to being a "panacea" for all ills than any other food. It is a protein of the highest order, contains rich stores of vitamin A and all of the members of the B group of vitamins. In addition, it is the greatest of all stimulators in the formation of red blood cells. Liver is an excellent source of iron and copper, but the power that it exerts in blood formation is out of proportion to this mineral content. Liver should be served once a week, and more often if desired.

Fish are commonly considered in two groups: those having a backbone (the vertebrates) and the shell fish. They may be further classified as fresh and salt water fish, lean or light fish and oily or dark fish. Salt water fish have the advantage of having a higher mineral content; this is of value as it pertains to fluorine and iodine. The dark or oily fish have a much higher fat content than the lean, a fact that may necessitate choice between them for therapeutic reasons. The nutritive value of fish as a meat alternative is often overlooked. Numerous feeding studies with laboratory animals have demonstrated that the

TABLE 14

COMPARATIVE AMOUNT OF PROTEIN IN SOME COMMON FOODS

FOOD	PROTEIN %	FAT %	TOTAL CARBOHYDRATE %	ASH %	WATER %	CALORIES (100 GM PORTION)
Whole milk	3.5	3.9	4.9	0.7	87.0	68
Skim milk	3.5	0.1	5.1	0.8	90.5	36
Nonfat dry milk solids	35.6	1.0	52.0	7.9	3.5	362
Whole egg (raw)	12.8	11.5	0.7	1.0	74.0	162
Egg white	10.8	0.0	0.8	0.6	87.8	50
Cottage cheese (skim milk)	19.5	0.5	2.0	1.5	76.5	95
Cheddar cheese	25.0	32.2	2.1	3.7	37.0	398
Lamb chop (rib, cooked)	24.0	35.0	0.0	1.2	40.0	418
Pork chop (loin, cooked)	23.0	26.0	0	1.2	50.0	333
Beef steak (sirloin, cooked)	23.0	22.0	0	1.1	54.0	297
Mackerel (raw)	18.7	12.0	0	1.2	68.1	188
Liver (beef, cooked)	23.6	7.7	9.7	1.8	57.2	208
Tongue (beef)	16.4	15.0	0.4	9.0	68.0	207

Adapted from U S Department of Agriculture Handbook No 8 Composition of Foods Raw Processed Prepared

nutritional value of fish products is equal, and sometimes superior, to that of beef, the meat used for comparison Research has indicated that the proteins from fish contain the essential amino acids in proportion to permit economical utilization of the protein Besides being a "tasty" food, fish often costs substantially less than meat So, from both a nutritional and a budgetary standpoint, fish is an excellent source of protein

While **legumes** *(beans, peas, lentils and peanuts)* are classified as vegetables, they supply protein which has considerable value when supplemented by a small amount of animal protein Lima beans have a protein value of 8%, soybeans, 13%, and peanuts and peanut butter, 26%

Nuts are usually listed as fatty foods due to their high fat content but their protein content is likewise high, from 15 to 30%

Cereals have a protein value of roughly 10%

These proteins certainly should not be neglected when the high cost makes meat difficult to obtain in adequate amounts

One of the objections to the use of dairy products and eggs as the exclusive source of animal protein is their low content of niacin, one of the B vitamins necessary for the prevention of pellagra (See Chapter 12) As has been pointed out, reliance on an egg and a pint of milk as the source of animal protein will yield only about 1 mg of niacin, whereas a serving of steak would yield 6 mg a serving of liver 16 mg, and a tablespoon of peanut butter 16 mg, essentially the day's recommended allowance All of this emphasizes the need for variety in the diet if adequacy is to be obtained

Cooking of meats serves a threefold purpose First like other foods, cooking improves the palatability of meats by making them more attractive and more flavorful Second in many instances cooking renders meat tender and more digestible And third, in the case of pork products cooking serves as a health measure as it destroys the harmful organism the parasite *Trichinella spiralis* Any meat including those popularly considered "indigestible" are entirely suitable for general use Today it is believed that long cooking at lower temperature results in a more satisfactory product Thus a difference in tenderness is more a matter of cooking than the animal host

It is necessary to process animal foods to facilitate transportation and storage The methods most frequently used are heating, freezing drying and canning As each process modifies the character of the fresh material some loss in nutritive value may result

In quick freezing and subsequent low temperature storage, foods can be kept safely in a state approximating fresh food for longer periods of time if protected against oxidation Frozen foods seem to retain their nutritive value

Howe in writing of specific cases of the *effect of food processing* of protein foods upon the nutritive value, remarked "There is considerable evidence that the ordinary processes of cooking and processing of foods for human consumption do not seriously affect the nutritive value of the proteins in the amounts used in the average mixed diet" However he went on to state that there were considerable losses in the vitamin content of processed animal foods in home preparation and processing and in subs-

quent storage This seems to occur when foods are processed, such as dried, then stored, prepared for serving, and then, perhaps, kept warm for serving.

A committee of the Food and Nutrition Board of the National Research Council prepared a report on the literature to date (1950) which was related to the problem of heat injury to dietary protein From the information available, there seemed to be little injury by the methods now in use to the important protein foods, meat, and milk The data showed, however, that there seems to be a marked deterioration of the protein value of the ready-to eat breakfast cereals This was believed due to the current methods of processing An important relationship in supplementation exists, however, as these breakfast cereals are usually eaten in combination with milk Research has indicated that these processing methods render some of the amino acids unavailable for absorption

Review Questions

1 What are the structural units of proteins?
2 Distinguish between complete, partially incomplete, and incomplete proteins
3 What are the principal food sources of the complete proteins?
4 What function may the incomplete proteins fill in the dietary? Name sources of these
5 How does the chemical structure of protein differ from carbohydrate and fat?
6 What purposes do proteins serve? What is their most economical use?
7 How may the protein metabolism of the body be measured?
8 What is considered a satisfactory amount of protein to include in the daily dietary of adults for optimum nutrition?
9 Why is milk considered such an important protein food?
10 In what forms is milk sold?
11 What are other sources of protein?

Suggested Projects

1 What is your recommended allowance of protein? From your menus (your diet record of the week), use the tables of food composition in the Appendix to calculate your average daily intake of protein Is it too high? Too low? Why? What can you do to alter your diet pattern so *that you will meet your recommended allowance?*
2 From your menus list the protein foods you included Classify them according to the two major groups described in this chapter Determine the percentage each group contributed to your total carbohydrate intake.

3 What are the ten cheapest sources of protein on the market now?
4 What are the ten most expensive sources of protein on the market now?
5 Plan a low cost diet for one day that will furnish 60 to 70 gm of protein
6 Plan a day's diet for a vegetarian which excludes meat and eggs and which furnishes 60 to 70 gm of protein
7 Plan a day's diet to meet the protein needs of a girl between 16 and 20 without including milk in the menus Would such a diet be adequate? Check it after the discussion of vitamins and minerals

CHAPTER 6

THE FATE OF FOODSTUFFS

INGESTION, DIGESTION, ABSORPTION, UTILIZATION

The reduction of food for absorption and its subsequent utilization within the human organism progresses in an intricate step by step pattern Recent research has indicated the interrelationship of certain vitamins and minerals in these reactions It is possible that future studies will disclose even greater participation on the part of other nutrients The psychic, motor, thermal, and chemical factors have been shown to strongly influence both the rate of digestion and the coefficient of digestibility

As indicated in Chapter 2, there are four major steps to the metabolism of carbohydrates, fats, and proteins in the living organism They are ingestion, the taking of food into the body, digestion, the preparation of food for cell use, absorption, the process whereby the breakdown products pass through the wall of the gastrointestinal tract, and utilization, the ways in which these constituents are carried by the blood to all cells of the body and are utilized as needed Each successive process is dependent on the action of the preceding operation

Ingestion, the eating of food, is usually a voluntary action Occasionally, one will find a patient who cannot eat or a child who is coerced into eating his meals, but, for the most part, an individual controls his food intake Many factors govern the food that we eat Many of these, such as likes and dislikes education custom and culture patterns, economic conditions, were discussed in Chapter 1 However, within the framework of these social and emotional influences, the primary factors controlling ingestion are hunger and appetite These two, hunger and appetite are so closely related that they are likely to become confused, and in the popular thinking, they are usually considered synonymous

Hunger has been described as a basic drive resulting from actual contractions of the stomach It is not believed to be influenced by previous experiences and can often be painful, as

demonstrated by the loud cries of a hungry infant. The pangs of hunger are not continuous in an empty stomach. They are usually not noticed if the individual eats three regular meals a day. Hunger may be inhibited by strong emotions and anger while outdoor exercise and physical activity in general may increase hunger.

Appetite, on the other hand, has been defined by Newburgh as "a sensation produced by happy memories." It is believed that appetite may be acquired and its existence depends upon previous experiences with taste, smell of food, and is actually an expression of the anticipation of the pleasure associated with food. The differentiation is clear when it is noted that hunger may be sated by the eating of a meal while appetite encourages the additional intake of a favorite dessert. Recent investigations with mice primarily have indicated that there may be a physiological mechanism which governs the appetite. Thus both appetite and hunger are important influences in the first step, ingestion of food, of the vital process nourishing the body.

The reliability of these two mechanisms as a guide in choosing the necessary foods for proper nutrition has been studied upon several occasions. Most investigators have found that when simple nourishing foods have been presented, children will, in the long run, choose foods that will provide the necessary nutrients. However, there are studies which indicate that a choice does not necessarily reflect what is good but rather what is liked. So the generally accepted belief seems to be that until more studies provide more conclusive evidence, neither appetite nor hunger can be depended on to guide the individual in the proper selection of the nutrients necessary for health.

Digestion is considered to be that process whereby the foodstuffs are changed into forms suitable for absorption and eventual body use. This process takes place within the gastrointestinal tract of the body. Fig. 14 illustrates the site of the important digestive organs of the alimentary canal (gastrointestinal tract). The first accurate knowledge of the activity of the gastrointestinal tract came about in 1822. Alexis St. Martin, a hunter, suffered a gunshot wound in the abdomen. Through the opening Beaumont observed the digestive reactions that took place and

described his observations in detail. St. Martin, who died at 83, had the abdominal opening throughout his life. Although some of the digestive fluids (which will be discussed presently) are

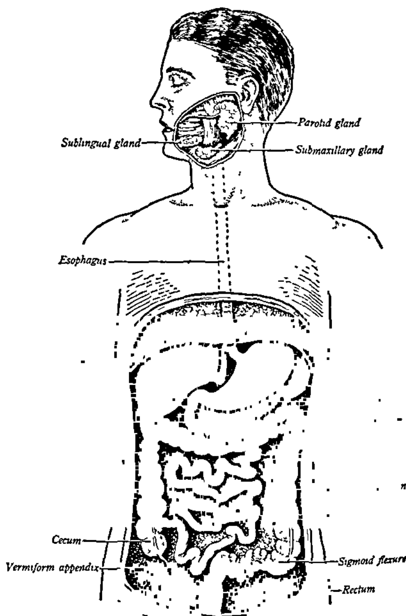


Fig 14 —Alimentary canal with digestive glands (From Kirkpatrick and Huettner Fundamentals of Health, Ginn and Co)

secreted from other sources, the gastrointestinal tract, along which digestion takes place, includes the following: the mouth, the stomach the small intestine, and, perhaps, the large intestine.

There are several factors involved in digestion (1) mechanical such as chewing and the motions of the gastrointestinal tract (2) chemical such as the pH of the alimentary canal and the activity of the enzymes and various secretions, and (3) regulatory factors as demonstrated by the flow of specific hormones and several inorganic materials As the process of digestion is discussed each of these factors will be pointed out in relation to the specific reaction taking place However it is important to note that all are necessary In the process of digestion the mechanical chemical and regulatory factors are all interrelated and dependent upon one another

The digestive process is essentially hydrolytic The active agents which bring about these changes are known as enzymes These enzymes are specific in action act within certain acidity (pH) ranges and in many instances are descriptively named An enzyme may be defined as an organic substance which is produced by the living cells and has the ability when mixed with other organic material to bring about certain chemical changes without entering into the reaction itself In other words an enzyme can be classed as a catalyst

Some enzymes are known by their early names, however recently a newer nomenclature which follows the suggestion of Duclaux is universally used Each hydrolytic enzyme is designated by the addition of the suffix ase to the kind of substance it acts upon For example an amylase is a starch splitting enzyme a lipase a fat splitting enzyme and a protease a protein splitting enzyme In addition the enzyme can be further identified by indicating the source of its secretion One may speak of a pancreatic lipase or a gastric lipase For simplification the substance upon which the enzymes act is referred to as the ' substrate Thus starch is the substrate of the pancreatic amylase and so on

Recently some enzymes have been recognized to exist in the inactive form in the cells The enzyme in an inactive state is called a zymogen and the characteristic ending is added to the name of the specific enzyme to indicate that it is in an inactive state For example trypsinogen is a zymogen or specifically is the enzyme trypsin in an inactive state

Enzymes those that we know to exist as zymogens as well as all others about which this point is not clear have to be activated

in order to participate in digestion Many substances may activate enzymes or serve as stimuli These may be hormones, other enzymes, inorganic salts, or mechanical, psychic, chemical, or thermal stimuli Each of these will be indicated as the specific role is discussed Each enzyme has its specific activator or a combination of two or three of the substances which have been identified as possible activators

As mentioned in previous chapters, cooking primarily serves to improve the palatability of foods, however, in some cases, preparation aids in digestion This is true with starches, as illustrated in Chapter 3, when the membranes are dissolved by moist heat, thus making the swollen starch granules available to the digestive enzymes Proper frying of foods increases the ability of the digestive enzymes to cope with the large quantities of fat ingested Seldom does cooking improve the nutritive value of foods *An outstanding example of such improvement is the* proper preparation of soybeans and egg white

The *mouth* is the first site of digestion Through the act of *mastication, food is broken down into small particles,* is well moistened with saliva and is prepared for the action of the digestive enzymes

***Saliva** is the first secretion of the gastrointestinal or digestive* tract It is poured into the mouth from several glands

Saliva contains one principal enzyme and perhaps several others Ptyalin or salivary diastase is the primary enzyme, whereas some literature indicates the presence of maltase, lactase, lipase, urease, and protease Ptyalin acts upon the starches, provided they have been properly cooked, and changes them to maltose While cooking has no digestive action upon starch, it does render it more available to digestive enzymes by rupturing the starch granules (see illustration under discussion of carbohydrates) Ptyalin has little effect upon raw starch The sweetish taste which develops when a bit of cooked starch is held in the mouth is evidence of the change from starch to dextrins (intermediary products in the breakdown to maltose), as the result of enzymatic action

The discharge of saliva (there may be *1,000 to 1,500 c c daily*) is under psychic control Even the sight or thought of palatable food especially when hunger is present, normally results in the "mouth watering" Animal experiments indicate that as the

mouth waters, or saliva gathers in expectation of work to do, so are the digestive juices in other regions of the digestive tract summoned for action The actual tasting of palatable food intensifies this effect The end result is optimum digestion This is an important factor in meal planning Pleasant anticipation of meals and enjoyment during mealtime are also important factors It can be further demonstrated that anger, fear, or extreme fatigue are factors in retarding the secretion of digestive juices and normal digestive activity Chlorine and bromine have also been shown to be activators of the secretion of saliva The pH of the mouth varies from 6 4 to 7 3 However, ptyalin can react over a range of pH 4 to 9

Saliva also contains traces of maltase which may convert some maltose to glucose

The action of saliva begun in the mouth is continued in the stomach until such time as the acidity of the gastric juice permeates the food mass and stops salivary action Saliva is not far from neutral in reaction and its activity is inhibited by highly acidic or basic conditions

From the mouth food passes down through the esophagus or gullet to the stomach in approximately five seconds by means of wavelike propulsive motion known as peristalsis A contracted band at the end of the esophagus, called the cardia or cardiac sphincter, guards the entrance into the stomach This sphincter is relaxed by the oncoming wave The stomach is not of definite size, but is an elastic organ adjustable to the volume of its contents

Contrary to popular belief the *stomach* is less a digestive organ than a reservoir It is true that important protein digestion takes place there but its more important job is that of slowly admitting food into the small intestine where the major act of digestion is carried on

It is said that the **gastric juice** appears on the lining of the stomach as profuse perspiration appears on the skin It is secreted in the fundic end of the stomach (the upper or cardiac end) as a clear, water fluid in amounts of two to three liters daily

The production of gastric juice as well as other digestive juices, is subject to hormonal control A hormone may be defined as a substance which cells in one part of the body produce

and pour into the blood stream for action elsewhere The first of these hormones of the digestive tract, in order from above down, is gastrin Gastrin, as its name implies, acts in the stomach It is formed in the lower part of the stomach and the upper part of the small intestine in response to the mechanical pressure of food It is absorbed into the general circulation and *goes to all tissues of the body Only one section responds, how* ever, the lining of the stomach where the stimulus originated The stomach continues to secrete gastric juice as long as food is in the stomach When food is no longer present, gastrin ceases to be produced As a result of this hormonal control the secreting cells have periods of rest

The gastric juice contains 0 2 to 0 4% hydrochloric acid and is therefore, strongly acidic Abnormally high acidity is known as hyperacidity, or hyperchlorhydria, and abnormally low acid con tent is known as hypoacidity, or hypochlorhydria Achlorhydria refers to the absence of hydrochloric acid One of the primary *purposes of the hydrochloric acid content of the gastric juice* is to provide the proper pH for the action of the enzymes Other functions of hydrochloric acid are to act as an antiseptic in in *hibiting the growth or destroying certain harmful bacteria, and* it is possible that it might exert a slight hydrolytic action on the disaccharides

Pepsin is the most important constituent of the gastric juice It exists in the inactive form as pepsinogen but, in the presence of hydrochloric acid, pepsinogen is converted to pepsin It acts upon proteins and reduces them to cleavage products known as proteoses and peptones (see classification of protein, Chapter 5) These cleavage products are later reduced to amino acids in the small intestine

It was formerly thought that the gastric juice also contained rennin It is now believed that rennin occurs in the fourth stomach of the young calf and in other animals, but not in either the infant or adult human being It was thought that rennin *was necessary to curdle milk, however, recent research* indicates that casein is precipitated by both pepsin and hydrochloric acid The commercial rennins such as Junket, which also curdle milk are prepared from the lining of the *calf's stomach*

Gastric lipase which acts on the fats, is the fourth digestive ingredient The value and extent of the juice is a somewhat con

troversial matter The optimum pH for its activity is about 7 8 and the pH of the stomach is far below its range Because of the highly acid condition it is doubtful if unemulsified fats are emulsified in the stomach However it has been suggested that if any activity occurs on the part of the gastric lipase it is to perform on the preformed emulsions such as milk cream and egg yoll

In the stomach absorption of water salts sugar alcohol and certain drugs may take place but absorption is really a function of the small intestine

Mechanical pressure is exerted by stomach muscles on the food while it is in the stomach but the food is not churned and mixed in the manner of popular thought These movements take place in orderly fashion The fundic end of the stomach acts as a storehouse for food which in the pyloric end of the stomach is subjected to active digestion At the pyloric or antrum end of the stomach the food is thoroughly mixed with gastric juice and is broken up by this process and by the mechanical action of the stomach musculature When this action is complete and the stomach contents are well acidified relaxation of the sphincter guarding the stomach intestinal junction (the pylorus) takes place This opening of the pylorus is activated by the consistency of the food mass by the tension of the stomach muscles by fullness or emptiness of the duodenum and by peristaltic waves within the stomach As the fluid or semifluid mixture of food material known as chyme passes down through the pyloric sphincter the upper portion of the stomach slowly contracts upon the food mass held there and forces it down into the lower portion where more active digestion takes place

The length of time food remains in the stomach is dependent upon several factors The stomach may be emptied in one hour or emptying may require six or seven hours A carbohydrate meal leaves the stomach more rapidly than does a protein meal which in turn leaves the stomach more quickly than a meal of fat A combination of protein and fat remains in the stomach the longest This accounts for the "stick to the ribs" or satiety value of protein and fat foods Fat in quantity depresses the flow of gastric juice and slows up the emptying time The aver

age time required for the stomach to discharge an ordinary meal is three to five hours *Psychic factors, however, may interfere with this time*

The third section of the digestive tract is the intestines, which *are divided structurally, into two main parts, the small and the* large intestine, the latter being also called the colon The first ten inches of the small intestine adjacent to the stomach, is known as the duodenum, the next eight feet as the jejunum, and the remainder as the ileum There is no marked difference in these sections At the junction of the small intestine and the large intestine is the ileocecal valve or sphincter, and a small pouch called the cecum, at which point is situated the vermiform appendix *The ileocecal sphincter prevents too rapid passage of* material from the small intestine into the large intestine, and also prevents the back passage of fecal matter Passage of material *through this valve is sometimes spoken of as internal defecation*

As can be seen from Fig 14, the colon may be considered as sectional—ascending, transverse and descending colon, the S shaped curve known as the sigmoid, and finally the straight strip, the rectum which ends in the anal sphincter, the anus

The small intestine is about one inch in diameter and about twenty feet in length The large intestine is about two inches in diameter and five feet in length

Digestion is most active in the small intestine Here, again hormonal chemical, and mechanical factors work together Under the influence of the acid food mass upon the mucous membrane *of the duodenum a hormone known as secretin is pro*duced which reaches the pancreas by way of the blood and stimulates it to secrete pancreatic juice

In the same region of the intestinal wall from which secretion arises two other hormones are produced One, enterogastrone, inhibits the motions of the stomach, it prevents the stomach from emptying a fatty meal too quickly—before the intestine is ready to receive it This is a hormone with an inhibiting rather than a stimulating effect Inhibiting hormones are known as chalones

Another hormone cholecystokinin is produced when fatty food comes in contact with the intestinal wall, and stimulates the gall bladder to discharge its bile

Pancreatic juice bile and intestinal juice are poured almost simultaneously into the duodenum about three to four inches

below the stomach small intestine junction (or pyloric sphincter) These juices mutually interact upon each other and upon the incoming food

At the present time it is believed that the pancreatic juice contains six enzymes with the possibility of two more (1) *Pancreatic diastase* which is similar in action to ptyalin of the saliva It is also known as *amylopsin* or *amylase* It is capable of splitting starch to maltose Even uncooked starch can be hydrolyzed to a slight extent by this enzyme However uncooked starch is only slowly acted upon and when large amounts are included in the diet the major portion will appear unchanged in the stool Bromine and chlorine are believed to activate the secretion of amylopsin (2) *Lipase* or *steapsin*, whose work is the break down of the emulsified fats into fatty acids and glycerin (glycerol) (3) *Trypsin* the protein splitting enzyme or more correctly the inactive form of trypsin—its precursor trypsinogen This enzyme as it appears first in the pancreatic juice has no digestive power It becomes activated by an admixture with the activator the enterokinase of the intestinal juice and is thereby rendered capable of partially breaking down the protein molecule Unlike pepsin it does not require hydrochloric acid for its action (4) *Chymotrypsin* appears in the inactive form chymotrypsinogen and its activator is trypsin Its specific function is to bring about the further breakdown of the protein products of peptic and tryptic action The optimum pH for both trypsin and chymotrypsin is near 8 to 9 (5) The third proteolytic enzyme is *carboxypeptidase* This enzyme attacks peptides (the near complete breakdown of proteins) containing a free carboxyl group Thus free amino acids are split off This is part of the enzyme which was formerly called erepsin (6) *Nucleases* form part of the pancreatic juice Their function is to split the various nucleic acids such as yeast nucleic acid and thymus nucleic acid into component mononucleotides There is some indication that the pancreatic juice may contain two other enzymes lactase and sucrase

The extreme activity of enzymes is demonstrated by a study at Columbia and quoted by Dr Sherman in *The Science of Nutrition* In 30 minutes at body temperature pancreatic amylase digested roughly 20 000 times its weight in starch and about 10 000 times

of time, it digested 4 000,000 times its weight in starch and 2 800,000 times its weight in maltose before becoming completely inactivated This activity was at a dilution of 1 to 100,000,000 parts of water This enzyme and others have been prepared in crystalline form and are proteins

The **intestinal juice**, succus entericus, or duodenal juice, also contains eight enzymes Four of these are concerned with carbo hydrate digestion, two with protein digestion, and one with fat digestion The eighth, enterokinase which was mentioned previ ously, serves as an activator for trypsin of the pancreatic juice Secretion of the intestinal juice is under the control of two hor mones, enterocrinin and secretin (the latter also contributes to the control of the flow of the pancreatic juice) In addition both the nervous system and mechanical stimuli contribute to the secretion of the intestinal juice The secretion varies at different points along the intestinal canal Its pH is usually about 8 3 and, since it is difficult to obtain intestinal juice, its components are far from clear It is not at all sure if these enzymes are actually secreted here

The four enzymes concerned with carbohydrate digestion are *amylase, sucrase, lactase,* and *maltase* These reduce the carbo hydrates into their constituent monosaccharides *Aminopeptidase* splits off an amino acid from a peptide at the end having a free amino group, and *dipeptidase* completes the final breakdown of proteins to amino acids The bile salts activate an *intestinal lipase*, but it is doubtful if it is very effective

Bile, which is prepared by the liver, concentrated and stored by the gall bladder, is primarily associated with the digestion of fats The bile salts are a constituent of bile, and their primary function is to emulsify the unemulsified fats, thereby rendering them more accessible to the digestive enzymes Other functions of bile associated with digestion are the accelerating action of pancreatic lipase and being alkaline it helps to maintain the proper pH of the small intestine Bile also has a major function in aiding the absorption of the fatty acids and the fat soluble vitamins It is believed that the secretion of bile is subject to the control of the hormone cholecystokinin, however the most effective stimulus for flow of bile is fatty food Thus, bile is not a digestive enzyme in the strict sense of the word About one pint of bile is poured into the duodenum daily When, for any

reason this does not occur, fat absorption is halted and fatty acids are excreted in the stool; both fat and fat soluble vitamins are thereby lost. Bile has a retarding action on intestinal putrefaction and stimulates peristalsis

Just as food is carried after swallowing (deglutition) into the stomach by **peristaltic action**, so it is propelled throughout the length of the gastrointestinal tract. At intervals it is pushed back by an antiperistaltic wave, only to be carried forward again and further admixed by rhythmical movement or series of local constrictions These three types of movement produce ideal conditions for digestion and absorption throughout the small intestine



Fig 15 — A bit of the lining of the small intestine is shown cut through and extending away from the observer The eminences are villi with capillary nets inside the slender pits are glands (From Stiles Human Physiology W B Saunders Co)

Absorption takes place readily from the small intestine, and the greatest part of the available nutrients is therefore, absorbed before the intestinal contents reach the large bowel The final products of digestion the amino acids from proteins, the fatty acids and glycerol from fats, and the monosaccharides from carbohydrates, are formed slowly and at varying times in the digestive process, and these constituents are taken up by the blood as they become available Too great concentration at any one place or at any one time is thereby prevented

The physical make up of the small intestine renders it highly specialized for the duty of absorption Examination reveals the presence of many cross folds, visible to the naked eye. T

the microscope tiny fingerlike projections or villi are seen, much like the nap on velvet These make it possible for innumerable epithelial cells to come in contact with the intestinal contents Here, again the efficiency of hormonal control is evident Villikinin stimulates the villi of the intestine to wave more rapidly This makes it possible for the villi to conserve energy when food is absent from the intestinal tract

On the inside of the intestinal wall is the intestinal contents on the outside of the membrane is lymph bathing the cells and running about both are the capillary vessels carrying blood Formerly it was believed that the major part of the digested food particles "soaked" through the epithelial cells of the villi passed through the lymph, and entered the capillaries However, recent evidence indicates that the cells actively participate in the process of absorption instead of assuming the role of a "passive filter barrier" It has been suggested that there are four factors which occur in the absorption of foods diffusion, osmosis, solution, and electrical properties A discussion of the characteristics of these four factors is beyond the scope of this book The possibility has been proposed that there are still many unknown factors associated with this complex mechanism, absorption

Carbohydrates are believed to be absorbed by a dual procedure diffusion and phosphorylation This latter exists when the simple sugars combine with phosphoric acid Members of some of the B complex are necessary for this reaction to take place The rates of absorption vary, with galactose being most rapidly absorbed glucose second, and fructose third

The water soluble amino acids pass through the intestinal wall by diffusion It has been suggested that some intact protein molecules may be absorbed, but this probably occurs under certain conditions and to a limited extent

There is a variety of beliefs concerning the absorption of fats The glycerol fraction is water soluble and is believed to follow a pathway similar to that of the carbohydrates Some believe that the combination of bile salts and fatty acids pass into the cells of the wall of the intestine, are recombined into true fats (different from the original food fat), pass into the lymph, and then into the large thoracic duct The bile salts are released and then returned to the liver for future use Others have found

evidence to suggest that some food fat may be dispersed in a very fine emulsion so that it can be absorbed intact The newer partition theory has demonstrated that a mixture of bile free fatty acid and a monoglyceride can emulsify fats to a state fine enough for absorption In absorption these mixtures do not pass through the lymphatic system but directly to the blood

Little is known about the modifications of minerals throughout the intestinal tract and the factors influencing favorable absorption Since each mineral seems to be affected differently the problems of absorption will be discussed in the chapter related to minerals Similarly the absorption of each vitamin will be discussed in the sections concerned with both the fat soluble and the water soluble vitamins

After absorption a variety of uses awaits each of the food stuffs carbohydrates fats and proteins As indicated in Chapter 2 the primary function of carbohydrate is to provide energy for the body The monosaccharides galactose and lactose are converted (by an unknown mechanism) in the liver to glucose The glucose content of the blood is the means whereby the cells throughout the body receive their energy Thus if necessary immediately upon absorption glucose may circulate in the blood to meet the energy needs of the body In fact as will be discussed in detail in the chapter on Diabetes Mellitus the glucose level of the blood rises considerably following a meal rich in carbohydrates If the carbohydrate content is in excess of the immediate needs of the body it is thought to be converted to glycogen as a temporary fuel reserve Most of the glycogen is stored in the liver however there are small amounts found in the tissues This conversion is believed to be a phosphorylation process (in combination with phosphorus and again members of the B complex are necessary for this action as well as the hormone insulin However if the carbohydrate intake is high the excess will be changed to adipose tissue to serve as a reserve fuel

The fats not used immediately for protoplasm can be used as fuel In this process the fatty acids must be oxidized in the liver and choline one of the B complex vitamins is necessary for this reaction The tissue cells complete the oxidation of fatty acids for fuel Again other members of the B complex must be present Fats that are not needed for protoplasm or for fuel are converted to adipose tissue to serve as a reserve fuel

Amino acids are absorbed and circulated rapidly in the blood for a few minutes If any cell needs a particular amino acid, it will "pick it up" from the blood as the acid circulates An immediate need for amino acids may be for protein synthesis This may be either for upkeep of body proteins, for new tissue such as in periods of growth, or for the manufacture of amino acid derivatives, like hormones and enzymes In the synthesis of protein, the body can synthesize all but the essential amino acids This is done by a process in the liver in which "trans amination," whereby the amino group (the nitrogen fraction) is transferred from one amino acid to another, may be a part When the protein intake is beyond the body's need for amino acids, the amino group is detached by liver action from the non nitrogenous fraction of the amino acid This is a process known as "deamination " The amino group containing the nitrogen is sent to the kidney, where it forms ammonia, which usually com bines with carbon dioxide to form urea and is excreted in the urine The non nitrogenous fraction, then, is free to enter into a variety of reactions If necessary it may serve as an imme diate source for fuel and be converted into glucose Or, it may be converted into adipose tissue to act as a reserve store of fuel for the body All of these reactions are believed to take place in the liver

In the large intestine the residual matter becomes more and more solid as it passes toward the anus Very little absorption other than of water takes place here and no digestive process The large intestine is a storehouse for the convenience of the active small intestine much as the stomach is a storehouse

The feces or stool contains the end products of the ingested food which are, however, only a fractional part of the total fecal mass Bacteria, bits of epithelial cells, remnants of digestive juices, products of bacterial decomposition, inorganic salts and traces of undigested food, all go to make up the mass The vol ume of fecal matter passed daily is variable, but on an average diet it is between 100 and 400 gm as moist weight, or 25 to 100 gm of dry material

Approximately eighteen to twenty four hours elapse from the time of ingestion of food and final elimination of its waste prod ucts in the stool As long as four to five days, however, is not altogether uncommon

Bacterial action in the intestinal tract may become a matter of importance At birth the digestive tract is sterile and in adult life it is estimated that perhaps one hundred billion bacteria may act upon the intestinal contents daily The action may be either harmful or beneficial Under certain conditions attempts are made to alter the type of intestinal flora or bacteria through food adjustment Putrefaction of proteins and fermentation of sugars or either alone may appear if gastrointestinal activity is slowed Constipation and diarrhea likewise are caused by abnormalities in the digestive tract

The term **digestibility,** when speaking of foods has a variety of meanings In popular thinking the digestibility of a food usually refers to the ease or comfort with which it is digested However in the strict scientific sense digestibility usually means the degree that foods are digested in the digestive tract This latter connotation is called the coefficient of digestibility" and is expressed in terms of percentages A far larger percentage of food is digested and absorbed than is generally realized On an average 95% of all edible foodstuffs is digested and absorbed 92% of the protein 95% of the fat and 98% of the carbohydrate according to studies made by Atwater

The popular conception of digestibility the comfort of digestion can be understood when seen in relation to the rate of digestion of various foods It was pointed out that fats and mixtures of protein and fats are the last foods to leave the stomach In addition fats may produce an inhibitory effect on gastric secretion Thus after a meal rich in fats the individual experiences strong satiety value and may have a feeling of fullness" for some time When foods are improperly fried fat may coat the protein and carbohydrate particles and thereby prevent normal gastric digestion or irritating breakdown products may have developed Because of the length of time that foods are in the stomach carbohydrates passing through rapidly fats staying the longest the general impression has arisen that one food is easier to digest than another

Digestion complicated as it may be by psychic factors is dependent upon common sense for its optimum action The **psychic factors** are too frequently ignored in considering digestive disturbances and in ascertaining the reason for inadequate response to dietary regimen Any emotion such as anger fear worry

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Bacterial action in the intestinal tract may become a matter of importance. At birth the digestive tract is sterile and in adult life it is estimated that perhaps one hundred billion bacteria may act upon the intestinal contents daily. The action may be either harmful or beneficial. Under certain conditions attempts are made to alter the type of intestinal flora or bacteria through food adjustment. Putrefaction of proteins and fermentation of sugars or either alone may appear if gastrointestinal activity is slowed. Constipation and diarrhea likewise are caused by abnormalities in the digestive tract.

The term **digestibility**, when speaking of foods, has a variety of meanings. In popular thinking the digestibility of a food usually refers to the ease or comfort with which it is digested. However in the strict scientific sense digestibility usually means the degree that foods are digested in the digestive tract. This latter connotation is called the "coefficient of digestibility" and is expressed in terms of percentages. A far larger percentage of food is digested and absorbed than is generally realized. On an average 95% of all edible foodstuffs is digested and absorbed, 92% of the protein, 95% of the fat and 98% of the carbohydrate according to studies made by Atwater.

The popular conception of digestibility, the comfort of digestion, can be understood when seen in relation to the rate of digestion of various foods. It was pointed out that fats and mixtures of protein and fats are the last foods to leave the stomach. In addition fats may produce an inhibitory effect on gastric secretion. Thus after a meal rich in fats the individual experiences strong satiety value and may have a feeling of "fullness" for some time. When foods are improperly fried, fat may coat the protein and carbohydrate particles and thereby prevent normal gastric digestion, or irritating breakdown products may have developed. *Because of the length of time that foods are* in the stomach, carbohydrates passing through rapidly, fats staying the longest, the general impression has arisen that one food is "easier to digest" than another.

Digestion, complicated as it may be by psychic factors, is dependent upon common sense for its optimum action. The **psychic factors** are too frequently ignored in considering digestive disturbances and in ascertaining the reason for inadequate response to dietary regimen. Any emotion such as anger, fear, worry

TABLE 15

A SUMMARY OF DIGESTION

SITE	ACTIVATOR	ENZYME	SOURCE	REACTION	ADDITIONAL COMMENTS
Mouth	Chlorine Bromides Psychic influences	Ptyalin	Saliva	Starch—soluble starch—dextrin—maltose	1 Breakdown of food into small particles through the process of mastication 2 Saliva lubricates food 3 pH ranges from 6 4 to 7 3
Stomach	Gastrin (hormone)	Pepsin	Pepsinogen (zymogen) from gastric mucosa	Proteins—proteoses + peptones (characteristic peptide linkage)	1 Salivary digestion continues until food mass is acidified 2 Mechanical mixing of juices with food by means of muscular contraction
	HCl		Gastric mucosa		3 Three types of stimuli (a) psychic, (b) gastric phase (food), (c) intestinal phase
		Lipase	Gastric mucosa	Fats—fatty acids + glycerol (emulsified fats, such as milk, cream, egg yolk)	4 HCl provides favorable pH for pepsin, swells proteins, stimulates on disaccharides 5 Not certain if continuous secretion of HCl in man 6 pH ranges from 1 5 to 4 7 Fats inhibit gastric secretion—through hormone enterogastrone 8 No general agreement that gastric lipase is secreted 9 pH for gastric lipase is 7 8
Small intestine	Secretin	*Pancreatic juice*	Pancreas		1 Mechanical mixing by means of rhythmic contractions, peristalsis, and antiperistalsis
	Enterokinase (secreted by intestinal mucosa)	(1) Trypsin	Trypsinogen	Proteoses—peptones—polypeptides	2 pH ranges from 8 to 9
	Trypsin	(2) Chymotrypsin	Chymotrypsinogen	Catalyzes hydrolysis of breakdown polypeptides—amino acids	3 No general agreement that pancreatic lactase and sucrase is secreted

	(3) *Carboxypeptidase*		Splits off amino acid from peptide end having free carboxyl *group*
Chlorine Bromine	(4) Amylopsin		Starch—soluble starches—dextrins—maltose
	(5) Lactase		Lactose—glucose + galactose
	(6) Sucrase		Sucrose—glucose + fructose
Calcium salts Bile salts	(7) Steapsin		Fats—*fatty acids* + glycerol
Secretin (hormone)	*Intestinal juice*		
Enterocrinin (hormone)	(1) Amylase	Intestinal mucosa	Starches—dextrins—*maltose*
	(2) Maltase	Intestinal mucosa	Maltose—glucose + glucose
	(3) Sucrase	Intestinal mucosa	Sucrose—glucose + fructose
	(4) Lactase	Intestinal mucosa	*Lactose—glucose + glucose*
	(5) Amino peptidase	Intestinal mucosa	Splits off amino acid from peptide end having free amino group
	(6) Dipeptidase	Intestinal *mucosa*	*Dipeptides—amino* acids
	Gall bladder		
Cholecystokinin (hormone)	Bile	Manufactured by liver	Accelerates actions of pancreatic lipase
Fatty food	*Bile salt*	*Concentrated* and stored by gall bladder	*Lowers surface tension* and therefore aids in emulsification of fats Aids in absorption of fatty acids Aids in absorption of fat soluble vitamins

extreme fatigue, or excitement, has a depressing effect on the secretion of digestive juices and normal muscular activity. Appreciation of this psychic influence is expressed in the term psychodietetics—the cooperative program of the psychiatrist and the dietitian.

Conversely, happiness, pleasant surroundings, and palatable food are favorable to optimum gastrointestinal activity. Health notions and food fads obviously may be influencing factors Overeating, undereating, bolting of food, food that is too hot or too cold, excessive spicing, all eventually leave their mark. Postural defects and extreme malnutrition may mechanically interfere with the action of digestion Thus, good digestion, upon which health is dependent, is due to a combination of many important factors Table 15 summarizes the process of digestion.

Review Questions

1 What are the four basic steps in the metabolism of foodstuffs within the body? Define each one
2 What are the differences between hunger and appetite?
3 What are the organs concerned with the digestion of foods?
4 What is an enzyme? How does an enzyme react in digestion?
5 What is a zymogen? What is its function?
6 How does the cooking of food affect its digestion? Illustrate
7 What are the purposes of mastication?
8 What is meant by the term "activator"?
9 What are the factors which determine the length of time that food remains in the stomach?
10 What are the factors that influence the absorption of the end products of carbohydrate digestion? Fat digestion? Protein digestion?
11 List the functions of the liver in the utilization of foodstuffs as described in the present chapter.
12 What is meant by "the coefficient of digestibility"?

Suggested Projects

1 Follow the digestion of a glass of milk through the alimentary tract, naming the enzymes, related substances, and the nutrients they affect
2 Analyze the copy of an advertisement which is concerned with a product suggested as an aid to digestion

CHAPTER 7

INDIGESTIBLE FIBER IN THE DIET AND ITS RELATION TO HEALTH

In order that the intestines may properly perform their function there must be present in the diet a certain amount of roughage for the production of bulk Very few foods are absorbed by the body to the point that no residue is left and there is therefore a certain amount of undigested material naturally present which cannot be considered entirely waste matter because it plays this important role in intestinal activity Some of our foods naturally leave a rather large proportion of residue for example the whole grain cereals the leafy vegetables and the fruits In the normal diet there should not be an extreme in either direction A well planned diet is one that will produce an adequate amount of bulk for optimum gastrointestinal activity

In addition to the bulk effect Williams and Olmsted found from studies on medical students that a chemical stimulus arises from the action of bacteria on hemicellulose and cellulose This fermenting material when mixed with the other fecal mass gives a stool of both bulk and soft consistency Bran carrots corn germ meal beet pulp and cabbage were definitely laxative Spinach turnip greens cauliflower lettuce celery peas beans peaches apples pears melon and berries were also effective in promoting satisfactory bulk especially when the fruit skins were also eaten

This roughage bulk residue or undigestible material is of two general classes the harsh or rough roughage such as the bran layer of cereals the seeds of fruits and vegetables and the skins of some foods and the softer roughage which is composed of the indigestible fraction left by most fruits and vegetables In some conditions it is wiser to plan for the second type of bulk Bulk may also be obtained by ingesting one of the polysaccharides (see Chapter 2 Carbohydrates) such as agar agar or psyllium seed These substances after absorbing water from the intestinal tract swell to a soft bulky mass which passes as such through the intestinal tract

Certain conditions require that bulk content be limited This may be done by choosing concentrated foods that contain little residue, meats, milk, cheese, eggs, or by choosing such vegetables as the flowerets of cauliflower, the top buds of broccoli, the tips of asparagus, young tender carrots, and other vegetables which might be rubbed through a strainer (puréed) and leave no residue In serving these vegetables, it is more desirable to present them in their natural form They have more eye appeal and are more satisfying Simply peeling fruit and removing the seeds may automatically throw it into this class of foods The removal of the bran layers, with the adhering germ, from cereal products eliminates a good deal of roughage, but it must be borne in mind that when this is necessary, compensation should be made for the loss of minerals and vitamins contained in the bran and germ This may be done by returning the wheat germ after it is separated from the bran to the "patent" or milled flour, or reinforcing the flour with crystalline vitamins Or the wheat germ may be sprinkled on cereals and put into or on other foods and eaten The germ has a residue content of only about 2% and is an excellent source of the vitamins B and E A diet containing cereal and several servings of vegetable or fruit, in addition to meat, milk, and eggs, will contain a satisfactory bulk content for the normal individual

Review Questions

1 Why is it necessary to have some roughage in the diet under normal conditions?
2 Distinguish between harsh and soft roughage
3 What foods leave little residue after digestion?
4 How could the normal diet be adjusted to low residue or "smooth" diet?

CHAPTER 8

ENERGY METABOLISM

Energy intake which is supplied solely by food is transformed in the animal into energy for various activities This transformation the oxidation of foods by body tissues results in the liberation of heat the maintenance of body temperature and the production of energy for the routine work and for extra physical activity Both the calorie content of foods and the calorie expenditure of these reactions may be measured directly or estimated by the use of tables which are formed from the results of extensive research

As Kleiner stated The demonstration of the laws of conservation of matter and energy has been made again and again for animate as well as inanimate matter Matter is transformed chemically and physically but none is lost and none gained energy is changed from one form to another but here too there is neither loss nor gain These transformations of matter which have been described elsewhere can be termed metabolism Traditionally metabolism has been subdivided into two separate phases anabolism the building up of body tissues and catabolism the breaking down of either tissues or substances Energy metabolism or the transformation of energy within the body, will be discussed here This itself as all metabolic reactions is both anabolic and catabolic

The measurement of energy is in terms of the unit **calorie** The calorie is defined as the amount of heat necessary to raise 1 kilogram (2 2 pounds) of water 1° Centigrade (or 4 pounds of water 1° Fahrenheit) * The oxidation of foods within the body results in liberation of heat It was Lavoisier the French scientist who demonstrated that the heat from the body was obtained from oxidation in the same way as heat was obtained from any other oxidation Heat loss from the body can therefore be expressed in terms of calories Since foods are the source of energy the energy value of foods can be expressed in representative calorie value

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*This calorie is s neti es calle t the large calorie to di tinguish it from the s all calorie which is the heat necessary to raise 1 gram of water 1° C nt grade Formerly the large calorie as d stinguis ed from the sma l calor e by the use of a cap tal C Howe er ina u h as the s nall calo e is very rarely used the ter n calo ie w th a sn all c is nov u ed to ind cate the large or kilogram calorie

Certain conditions require that bulk content be limited This may be done by choosing concentrated foods that contain little residue, meats, milk, cheese, eggs, or by choosing such vegetables as the flowerets of cauliflower, the top buds of broccoli, the tips of asparagus, young tender carrots, and other vegetables which might be rubbed through a strainer (purèed) and leave no residue In serving these vegetables, it is more desirable to present them in their natural form They have more eye appeal and are more satisfying Simply peeling fruit and removing the seeds may automatically throw it into this class of foods The removal of the bran layers with the adhering germ, from cereal products eliminates a good deal of roughage, but it must be borne in mind that when this is necessary, compensation should be made for the loss of minerals and vitamins contained in the bran and germ This may be done by returning the wheat germ after it is separated from the bran to the "patent" or milled flour, or reinforcing the flour with crystalline vitamins Or the wheat germ may be sprinkled on cereals and put into or on other foods and eaten The germ has a residue content of only about 2% and is an excellent source of the vitamins B and E A diet containing cereal and several servings of vegetable or fruit in addition to meat, milk, and eggs will contain a satisfactory bulk content for the normal individual

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CHAPTER 8

ENERGY METABOLISM

Energy intake, which is supplied solely by food, is transformed in the animal into energy for various activities. This transformation, the oxidation of foods by body tissues, results in the liberation of heat, the maintenance of body temperature, and the production of energy for the "routine" work and for extra physical activity. Both the caloric content of foods and the caloric expenditure of these reactions may be measured directly or estimated by the use of tables which are formed from the results of extensive research.

As Kleiner stated: "The demonstration of the laws of conservation of matter and energy has been made again and again for animate as well as inanimate matter. Matter is transformed chemically and physically but none is lost and none gained; energy is changed from one form to another, but here too, there is neither loss nor gain." These transformations of matter, which have been described elsewhere can be termed metabolism. Traditionally metabolism has been subdivided into two separate phases, anabolism, the building up of body tissues, and catabolism, the breaking down of either tissues or substances. Energy metabolism, or the transformation of energy within the body, will be discussed here. This itself, as all metabolic reactions, is both anabolic and catabolic.

The measurement of energy is in terms of the unit **calorie.** The calorie is defined as the amount of heat necessary to raise 1 kilogram (2.2 pounds) of water 1° Centigrade (or 4 pounds of water 1° Fahrenheit).* The oxidation of foods within the body results in liberation of heat. It was Lavoisier, the French scientist, who demonstrated that the heat from the body was obtained from oxidation in the same way as heat was obtained from any other oxidation. Heat loss from the body can, therefore, be expressed in terms of calories. Since foods are the source of energy, the energy value of foods can be expressed in representative calorie value.

*This calorie is sometimes called the large calorie to distinguish it from the small calorie which is the heat necessary to raise 1 gram of water 1° Centigrade. Formerly the large calorie was distinguished from the small calorie by the use of a capital C. However, inasmuch as the small calorie is very rarely used, the term calorie with a small c is now used to indicate the large or kilogram calorie.

Lavoisier believed that it was perspiration which regulated heat loss from the body. *To substantiate this idea, he constructed* an apparatus to measure directly the heat given off by the body of a small animal in terms of the ice melted in a surrounding container. Today the energy metabolism of an animal or human being may be measured much more exactly by a calorimeter based on this early scheme. Lavoisier also realized that it was possible to measure the metabolism *indirectly by analysis of ex*pired air which contains the end products of the oxidative processes taking place within the body. The machines in common use today are based upon this latter conception.

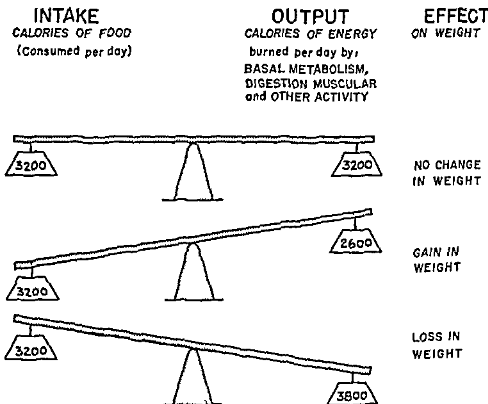


Fig. 16.—Relation of energy intake to energy output. *A person's body is* made up only of those substances which he has ingested. The human machine stores excess fuel and will burn reserve fuel when the present feeding is inadequate. (From Langston and Anderson: Health Principles and Practices. The C. V. Mosby Co.)

Man obtains energy only from the foods that he eats. However man expends energy in five basic reactions: basal metabolism, the specific dynamic action of foods, for mechanical work, in the regulation of body temperature, and in the process of

growth and repair The measurement of energy intake and the measurement of the various channels of energy expenditure will be discussed in detail Fig 16 illustrates the relation of energy intake to energy output When the weight remains the same, the energy intake has equaled the energy expenditure However, when the energy intake is greater than the energy expenditure, a gain weight may occur In the adult, this gain in weight may result in a storage of energy as adipose tissue, or may occur following a wasting illness Again, a positive energy balance, as this is called, may take place during periods of growth, both in pregnancy and in the growing child as a result of tissue formation These will be considered again in the appropriate chapters

Energy (Fuel) Value of Foods

The energy or the combustion heat value of a food may be determined by burning it (or any other substance desired) in a bomb calorimeter in an atmosphere of pure oxygen (Fig 17) The heat evolved is measured as a change in temperature of the water surrounding the "bomb Such determinations indicate that if one takes the *average* value obtained from the different components within the three food groups, it appears

1 gm of pure fat yields 9 3 calories
1 gm pure carbohydrate yields 4 1 calories
1 gm of pure protein yields 4 1 calories

or 9, 4, and 4 calories, respectively Fat and carbohydrate having the structure C(arbon), H(ydrogen), O(xygen), are burned completely to carbon dioxide and water Protein, with the structure C H O N(itrogen) P(hosphorus) S(ulfur), yields in addition to carbon dioxide and water a residue, and when correction is made for this incomplete combustion the average value for proteins becomes 4 1 calories per gram

From a chemical analysis which has resulted in the clarification of the composition of food, the energy value of the food may be calculated For example, the calorie value of a cup of milk may be calculated in the following way

	Gm		*Cal/Gm*	*Calories*
Protein	8 5	×	4	34
Fat	9 5	×	9	85 5
Carbohydrate	12 0	×	4	48
				167 5 for 1 cup milk

By such calculations and by actual burning of foods in the bomb calorimeter, tables of food values have been prepared This energy value of foods may be expressed as the amount necessary to yield 100 calories (the 100 calorie portion) (Fig 18), the amount yielded by 100 gm of food, or the calorie yield in the standard portion or "common household units" (detailed table in Appendix) Each form of expression has specific use When using a list of foods which yield 100 calories each, it is interesting

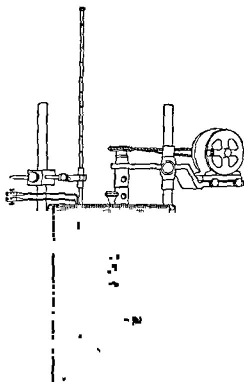


Fig 17—Cross section of Emerson fuel calorimeter (Courtesy Emerson Apparatus Co Melrose Mass)

to note the variations in the amount of each food The tables that contain 100 gm portions automatically represent the percentage composition of food For example, a 100 gm portion of milk contains 3 5 gm of protein, and, consequently, milk is 3 5% protein This listing of foods is often used for research purposes The last list that of the composition of the foods in terms of household units is used for most purposes In evaluating an individual dietary in calculating food intake of groups of people,



FIG. 18. One hundred calorie portions of a few familiar foods in terms of ordinary household measurements and of quantities commonly purchased. (Courtesy of the Bureau of Home Economics, United States Department of Agriculture.)

or in determining the nutrient value of a specific food, it is more practical to use the table of household portions. The nutritive value may be expressed as E.P. (edible portion) or A.P. (as purchased).

It must be recognized, however, that these tables of composition are merely approximations of the actual value of all such foods. There is considerable variation in composition, especially in the vitamin and mineral content. Similar variations were discussed in Chapter 3. These differences may be due to the soil, the weather, the variety of food, the maturity, and the period of storage. In addition, some differences may be related to the method of analysis itself. Table 137 in the Appendix is from the U. S. Department of Agriculture Handbook No. 8, *Composition of Foods: Raw, Processed, Prepared*. It has been included because it is the most recent, universally accepted table which contains suitable values in terms of our American food pattern.

Energy Expenditure

As indicated previously, the total energy expenditure of the individual is represented by a summation of five factors: basal metabolism, specific dynamic action, mechanical work, heat regulation, and growth. For the most part, the first three are those usually considered, while it is not always necessary to compute the energy expended in the latter two. In each of these expenditures, there are refined, precise laboratory methods for determining the heat produced and there are methods devised, based upon the results of the laboratory research, which are used clinically when it is impossible to carry out extensive examination on each individual patient. Both methods will be briefly considered here.

Basal metabolism is the metabolism of the body at complete rest, in a comfortable position, and comfortably warm and relaxed, both mentally and physically. The patient must also be in a postabsorptive state, i.e., the last meal must have been eaten twelve to eighteen hours previously. Since voluntary activity can be eliminated, and since such activity is extremely variable, metabolism is generally measured under basal conditions.

Basal metabolism as measured is not, however, the lowest level of heat production. Sleep produces a further lowering of from 10 to 13% in the rate. The determination upon a sleeping indi-

vidual is not practical, and, therefore, the minimum heat production under previously described conditions is considered basal

Several types of apparatus are available for the measurement of metabolism Fig 19 illustrates one of the clinical machines, designed for office and bedside use, which measures the oxygen consumption over a given period of time by the fall of a spirometer bell previously filled with oxygen The subject is part of the circuit Many other models are available and are equally as satisfactory as the one illustrated here The metabolic rate is calculated from the volume of oxygen consumed in a given

Fig 19—The Benedict Roth metabolism apparatus (Courtesy Warren E Collins Inc Boston)

time period under "basal" conditions The heat value is obtained "indirectly"—the oxygen consumption represents the extent of oxidation which has taken place within the body during the test period Fig 20 illustrates the mechanics of this action

In making such measurement it is found that for the same age, sex, and size, individuals produce surprisingly constant amounts of heat over the same time period if this heat is expressed on a basis of their surface area As a result of many determinations under carefully controlled circumstances on individuals who were

free from any condition which might affect their metabolism, we now have tables which may be used in comparing the results on any given individual against this standard Thus, we may determine the per cent variation the basal metabolic rate obtained is from the standard A value of +10 means that the individual has a basal calorie expenditure of 10% above the standard Each individual metabolic rate is expressed as + or − the per cent deviation A value within the range ±10% of the average is generally considered normal, however, some clinicians will accept a deviation as wide as ±20

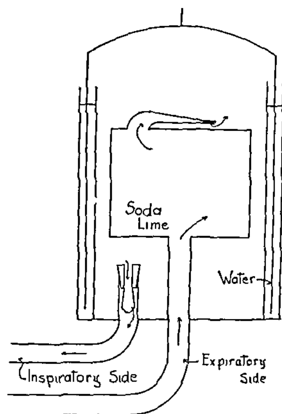


Fig 20—Diagram of the connections in the spirometer of the Benedict Roth apparatus (From Bard Macleod s Physiology in Modern Medicine The C V Mosby Co)

There are several factors which normally influence the basal metabolic rate Among the most important is the relationship of surface area to calorie expenditure which was demonstrated first by Voit and later by Rubner The metabolic rate may be expressed as calories per square meter of surface area per hour,

TABLE 16

METABOLISM OF VARIOUS WARM BLOODED ANIMALS

ANIMAL	WEIGHT IN KILOGRAMS	CAL/SQ M/24 HR
Horse	441 0	948
Pig	128 0	1 078
Man	64 3	1 042
Rabbit	2 3	776
Fowl	2 0	943
Mouse	0 018	1 188

or per twenty four hours which is the usual method in clinical and experimental studies That heat production is proportional to surface area rather than to weight is well demonstrated by Table 16 It is difficult to estimate the surface area but from experimental studies various tables and *'nomograms'* have been worked out so that the surface area may be estimated from the height and weight of an individual

In addition to surface area the basal metabolic rate is influenced by age and muscle tone The rapidly growing child and young adult have a higher metabolism than the older person or the aged The firm muscled athlete uses more fuel than the individual with flabby *underdeveloped muscles It has been reported that* undernutrition reduces the metabolic rate as much as 12% A man probably because he has more active tissues and less fat than a woman in proportion to his actual weight has a higher metabolic rate Glandular disturbances or conditions in which fever is present likewise influence metabolism An approximate increase of 7% in metabolic rate occurs for every degree Fahrenheit of increase in body temperature It has also been suggested that there may be some variation in the basal metabolic rate among races Evidence has indicated that white individuals often have a lowered metabolism when they live in tropical climates

Specific Dynamic Action

The effect of food to increase metabolism over the basal level was called "specific dynamic action" (sometimes spoken of as S D A) by Rubner Any food ingested in excess of that needed for immediate energy or structural purposes exerts this effect The feeding of pure foodstuffs indicates that the increase from each is not identical Roughly the increase from protein is 30 to 40%, from fat 4 to 14% and from carbohydrate 5 to 7% On the

average, food (which is mixed in terms of proteins, fats, and carbohydrate) causes an increase of some 10% above the basal level. The *explanation of this dynamic action is complicated and* not clear. Lusk stated that it is produced during the utilization of the food products by the body. In the past it was thought to be the "cost of digestion," but this concept has been disproved. Kleiner suggests, on the basis of current research, that perhaps the explanation to the S.D.A. of all foodstuffs may be the energy required to prepare the non-nitrogenous parts of the molecule for storage.

Whatever its cause may prove to be, this factor may be calculated and added to the basal metabolism as the second area of energy expenditure.

Mechanical or Muscular Activity

As soon as the individual engages in mechanical work or muscular activity, he increases his energy expenditure and, consequently, his heat production. The determination of the amount of energy utilized in various activities, which, for the most part, is merely an estimation, is difficult. This is usually found to be the most variable of the areas of energy expenditure.

By means of technically accurate metabolism machines, those *which measure both CO_2 and O_2, it is possible to determine indirectly* exactly the energy expenditure in the performance of various tasks. The subject may be connected to the circuit in the same manner as in the clinical basal metabolism test. He may work in a "respiratory chamber," a large box or room which is inserted into the circuit, or small sampling bags may be hung onto his back and, as work is performed, these may be removed as desired and taken to the laboratory for *later analysis of the expired air,* or, again, by temperature change of water carried in coils which line the surface of a sealed box, inserted in a ventilated circuit, in which the subject is placed. The increase in water temperature represents the heat given off from the subject's body. The metabolic rate is thus directly measured.

Such machines are too costly and difficult of operation for clinical use. *However, only when both the CO_2 and O_2* are measured are the data sufficiently accurate for research purposes From such research a large amount of data is available which are presented in tables such as Table 17. Other tables repre-

sent various activities expressed as the number of calories per hour per pound (or per kilogram) for a man and a woman Still other such tables show the energy expenditure in terms of the number of calories per square meter of surface area per hour In using this latter type of table, the surface area of the individual must be calculated according to either a formula or tables set up for that purpose

An examination of the data presented in Table 17 will demonstrate the wide variations found in different forms of activity The material for this table was gathered in an early study by E M Bedale (Proc Roy Soc, London 94 368, 1923) and quoted in the White House Conference report on nutrition The study was made on 45 boys and 45 girls ranging in age from 8 to 18 years, but divided according to height, weight, and general physical capacity, regardless of age into groups averaging 10 children each The values obtained on one group are sufficient to demonstrate the effect This group was composed of boys of an average age of 15¾ years, average height of 164 centimeters and average weight of 50 1 kilograms

Keys, in discussing the use of such tables in estimating the fuel cost of activity above the basal expenditure, made some fundamental observations He pointed out that these tables have some

TABLE 17

EFFECT OF ACTIVITY ON ENERGY EXPENDITURE

OCCUPATION	EXPENDITURE
Basal	40 86 calories per hour
Basal	0 68 calories per minute
Sitting	1 04 calories per minute
Standing	1 23 calories per minute
Walking	2 52 calories per minute
Running	5 24 calories per minute
Football	7 32 calories per minute
Gymnastics, etc	2 53 calories per minute
Quad, games etc	3 12 calories per minute
Outdoor work, heavy, etc	3 31 calories per minute
Outdoor work, summer, etc	3 54 calories per minute
Gardening	2 39 calories per minute
Workshop	2 07 calories per minute
Swim	5 93 calories per minute
Cold bath	3 93 calories per minute
Dressing	1 83 calories per minute
Bed making, etc	2 42 calories per minute
Siesta	1 09 calories per minute
Odds and ends, waiting about	1 80 calories per minute
Violin practice	1 25 calories per minute

interest in that they indicate the broad differences in energy expenditure among different activities and occupations However, in the light of modern technology, as the nature of work changes, occupations which formerly required large amounts of energy to perform now do not fit into the same groups In addition, larger groups of people are no longer classifiable in the older "more uniform crafts and trades." There are also wide variations in the ways in which different persons work at the same job so that one individual might expend far more energy than another. Today, with the reduction of hours of the work week, the number of hours that the individual spends in such activities as sports and hobbies is equally as important as the time spent at his occupation

TABLE 18

PER CENT INCREASE ABOVE BASAL METABOLISM TO ALLOW FOR ENERGY EXPENDED IN MUSCULAR ACTIVITY

20%	for people at "house" or "bed rest." This figure is used when the person is confined to bed, a room chair, or a wheel chair, as following a fracture of the leg, a crippling type of arthritis, a "stroke" or paralysis, heart disease, and in early convalescence from an illness
30%	*for people at moderately restricted activity but who are up and about* This generally includes people in late convalescence when not confined to the house but who are permitted to sit on the lawn, take short motor trips, take short walks, or be a sports spectator This group also includes most retired elderly people who voluntarily or on doctor's orders restrict physical activity to the minimum sufficient to prevent boredom
40%	for people with slightly restricted activity. The large group here are housewives who neither do their own housework nor engage in gainful outside work
50%	for people in the following light or home occupations—the white *collar occupations, machinery operators, housewives* who do their own work, domestic servants, chauffeurs, and similar workers
60%	for people who are moderately heavy workers, such as manual laborers farmers, truck drivers, and expressmen This also applies to most adolescent children who are obese
70 to 100%	for people who are engaged in heavy work, such as stevedores, lumberjacks, steel workers, and such

(From Jolliffe Reduced and Stay Reduced Simon & Schuster, Inc)

A method for estimating the amount of energy expenditure above the basal which has been widely used is that of adding a calculated per cent increase in fuel production to the basal requirement Table 18 offers a guide for determining the calculation of the energy expenditure for a given individual for his muscular activity It is not feasible from the dual standpoint of

TABLE 19

RECOMMENDED DAILY ALLOWANCES FOR CALORIES*

(Food and Nutrition Board, National Research Council, November, 1953)

	AGE YEARS	WEIGHT POUNDS	HEIGHT INCHES	CALORIES
Men	25	143	67	3,200
	45	143	67	2,900
	65	143	67	2,600
Women	25	121	62	2,300
	45	121	62	2,100
	65	121	62	1,800
	Pregnant (3rd trimester)			Add 400
	Lactating (850 ml daily)			Add 1,000
Infants	1/12–3/12	13 (6 kg)	24	kg × 120
	4/12–9/12	20 (9 kg)	28	kg × 120
	10/12–1	22 (10 kg)	30	kg × 120
Children	1–3	27	34	1,200
	4–6	40	43	1,600
	7–9	59	51	2,000
Boys	10–12	78	57	2,500
	13–15	108	64	3,200
	16–20	139	69	3,800
Girls	10–12	79	57	2,300
	13–15	108	63	2,500
	16–20	120	64	2,400

*These calorie recommendations apply to the degree of activity for the reference man and woman. For the urban white collar worker they are probably excessive. In any case, the calorie allowance must be adjusted to the actual needs of the individual as required to achieve and maintain his desirable weight.

time and expense to determine by means of an oxidation chamber the energy spent in this way. Use of such estimates as set forth in Table 18 has represented a practical approach to this part of heat production.

Contrary to popular belief, mental work does not effectively increase the total metabolism. Investigators have found that mental work only adds 3 to 4% to the total expenditure and for all practical purposes can be ignored.

Heat Regulation

While the problem of heat regulation is primarily a physiological one, it is important to include a brief consideration in a discussion of energy metabolism. The body of a warm blooded animal has a remarkably constant body temperature. Body tem

perature is the result of a fine balance of the heat production *against the heat elimination which is under the control of the* central nervous system

The **heat production** of the body results almost entirely from the oxidation of food The specific dynamic action may also be added to the total heat production which maintains body temperature Whenever the temperature of the surrounding atmosphere is lower than the body temperature, reflexes in the skin bring about an increase in the oxidative process which results in a higher production of heat If the temperature is still lower an involuntary movement of muscles occurs (known as shivering) and even more oxidation takes place thus still more heat is produced

Heat loss is both voluntary and involuntary action It occurs by such routes as radiation, convection, conduction, evaporation of water from the skin and lungs, and loss of heat in the excreta *The importance of each factor depends upon many conditions* Among the most significant are the environmental temperature the humidity, the presence of air currents, the presence or absence of fever, and the kind of clothing

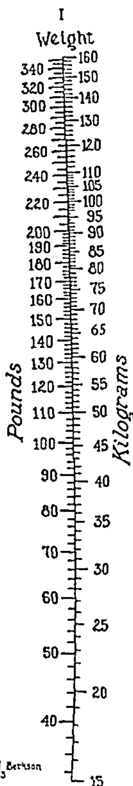
For the most part, the regulation of body temperature is easily maintained by the internal production of heat as the oxidation of food takes place and the regulation of heat loss by the voluntary wearing of clothing and maintenance of a favorable atmospheric temperature by modern methods of heating and air conditioning buildings

Growth

Growth itself may be defined as "a net increase in tissue substance" Whenever tissues have been laid down, an increased energy requirement has resulted This has been very difficult to estimate however, Jeans has suggested that the energy requirement for growth might be 15 to 20 calories per day per kilogram of body weight It must be remembered that growth is considered to occur when new tissue formation takes place Thus such processes as pregnancy lactation convalescence with repair of injured tissue, as well as growth during childhood would require additional energy expenditure

Food Nomogram

Directions The standards for age are arranged on the basis of the common method of expressing age as of the last birthday. To determine the desired calorie allowance, proceed as follows (1) Locate the weight on Scale I by means of a pin stuck through the eraser of a lead pencil. (2) Place the edge of the ruler against the pin and swing the other end of ruler to the patient's height on Scale II (3) Transfer the pin to the point where the ruler crosses Scale III which gives the surface area in sq meters (this value need not be read) (4) Holding the ruler against pin on the surface area scale, swing the left hand end of the ruler to the patient's standard for age and sex given on Scale IV (5) Transfer the pin to where the ruler now crosses Scale V which gives the basal heat production of the patient for 24 hours and represents the calories of food required by the fasting patient when resting in bed (basal calories) The calories necessary for activity bear a percentage relationship to those demanded for the resting condition The so-called "white collar worker" when at work will need about 50 per cent more than his basal calories When activity is restricted, as in the hospital, the extra calories necessary will range from 10 to 30 per cent of the basal calories Therefore (6) estimate the per cent of calories above the basal and locate this point on Scale VI With the ruler connect this point with the point located previously on Scale V, and where the ruler now crosses Scale VII read the amount of food calories to be provided by the diet



W M Boothby and J Berkson
October 1933

amples of undernutrition In the United States many cases of undernutrition may be due to physical factors that interfere with food consumption, food absorption, or storage, as well as some factors that are economic in origin

Keys has defined undernutrition as "a condition in which there is no dominant single nutrient deficiency except that of calories" In addition, a primary or secondary protein deficiency may exist, and frequently deficiencies of other nutrients such as the water soluble vitamins and iron, are present

The effects of caloric undernutrition are profound and lasting Among the general effects which are of specific interest here is the general weight loss Keys points out that one of the most constant and important facts in the starved person is a remarkably low basal metabolic rate Using the usual method of measurement, the rate may range from a −10 to a −50, the most severely undernourished persons having a low rate such as −30 to −40% If the basal metabolism is calculated in terms of unit of body weight, it is found that the "rate of oxygen consumption per unit mass of surviving metabolizing tissue is not seriously reduced but the total basal metabolism of the individual may be only half of the amount in the normal, prestarvation state"

The implications of this research may seem remote from the present study of nutrition However, through the FAO and WHO our interest in the problems of international nutrition is high Of direct relationship, however, is the nutritional status of many of our pre and postoperative and chronically ill hospital patients These will be discussed in Part III

Review Questions

1 What does the term energy metabolism mean?
2 What unit of heat is used to measure the heat production of the body?
3 What is basal metabolism?
4 What factors affect the metabolic rate?
5 What is the specific dynamic action of food?
6 What factor has the greatest influence in raising the metabolism above the basal rate?
7 What types of apparatus are used to measure metabolism?
8 How is the fuel value of foods measured?
9 What does the term undernutrition mean?
10 What effect does undernutrition have upon the basal metabolic rate?

Suggested Projects

1 Using the food nomogram (Fig 21), determine your own calorie expenditure Compare your findings with the recommendations of the National Research Council

2 Does the calorie value of your own menu approximate your estimated calorie expenditure? If not, do you observe a reflection in the deviation in weight gain or loss?

3 If possible, either participate in or observe the clinical determination of the basal metabolic rate

4 Using the food nomogram (Fig 21), determine the calorie expenditure for various persons of different age groups that you know. How do your findings compare with the recommendations of the National Research Council for each one?

CHAPTER 9

THE BLOOD AND LYMPH

Inasmuch as alteration in blood composition may result in widespread physiological changes, it is of value to know the average composition of blood in order to understand better the effects of deviation from the normal averages *For the sake of easy reference and review, this chapter is included* See Table 20 for a summary of values

Blood makes up 7 to 9% of body weight—a 70 kilo man would have roughly, 10 to 12 pints of blood A loss of more than half of this at any one time is fatal Less than half, if restored im *mediately will usually result in recovery*

Blood is a circulating tissue consisting of a fluid portion called plasma in which are suspended three types of formed elements the red blood cells (R B C) or erythrocytes the white blood cells (W B C) or leucocytes (sometimes leukocytes), and the platelets Dissolved in the plasma are gases and solid materials The formed elements make up about 45% of the volume of the human blood the plasma the other 55%

Blood has eight functions in the body It carries food ma terial (the metabolic end products of digestion) from the in testines to the tissues and oxygen from the lungs to the tissues The food materials are in solution, and the oxygen is carried in loose combination with the hemoglobin of the red blood cells as oxyhemoglobin Blood carries the waste products to the kid neys lungs skins and intestines depending upon the point of their elimination from the body It transports the hormones from the place of elaboration to the seat of action It brings about a uniform distribution of heat and so aids in the regulation of body temperature It aids in maintaining acid base and water balance Last because of its bacteriological antibodies blood forms a line of defense against disease

When whole blood is spun down in a centrifuge so that the fluid and suspended solid parts are separated it divides into formed elements and plasma If it is allowed to coagulate or

TABLE 20

COMPOSITION OF HUMAN BLOOD*

CONSTITUENT	NORMAL RANGE MG PER 100 ML †	PATHOLOGICAL CONDITIONS IN WHICH INCREASES (UNLESS OTHERWISE NOTED) MAY BE ENCOUNTERED
Total solids %	19 23	Anhydremia. Low in hydremic plethora and anemia
Total proteins (serum), %	6 5 8 2	Low in nephritis with edema (nephrosis)
Albumin (serum), %	4 6-6 7	Low in nephrosis
Globulin (serum), %	1 2 2 3	Nephrosis anaphylactic conditions malignancy, infections muscular activity
Fibrinogen (plasma), %	0 3 0 6	Pneumonia infections Low in cirrhosis of liver chloroform or phosphorus poisoning typhoid fever
Hemoglobin % (Haden)	15 6	Polycythemia Low in primary and secondary anemia chlorosis
Iron as Fe	*52*	*See Hemoglobin*
Copper	0 05 0 25	
Total nitrogen %	3 0 3 7	Varies chiefly with proteins (albumin globulin hemoglobin)
Nonprotein N	25 35	Nephritis, eclampsia etc See Urea N
Urea N	10 15	Chronic and acute nephritis metallic poisoning cardiac failure intestinal or prostatic obstruction some infectious diseases Relatively low in nephrosis
Uric acid	2 0 3 5	Nephritis gout, arthritis eclampsia
Creatinine	*1 2*	*Nephritis*
Creatine	3 7	Terminal nephritis
Amino acid N	5 8	Leukemia acute yellow atrophy of the liver severe nephritis
Ammonia N	0 1-0 2	Terminal interstitial nephritis
Undetermined N	4 18	Eclampsia
Glucose	70 100	Diabetes pregnancy severe nephritis
Total fatty acids	*290-420*	*Diabetes nephritis*
Cholesterol	150 190	Diabetes nephritis nephrosis biliary obstruction pregnancy Low in pernicious anemia
Lipid phosphorus	*12 14*	*Diabetes nephritis pregnancy In anemia low in plasma high in cells*
Total acetone bodies (as acetone)	0 8 5 0	Diabetes
Acetone + acetoacetic acid (as acetone)	0 1 2 0	Diabetes
β Hydroxybutyric acid (as acetone)	0 5 3 0	Diabetes
Bilirubin	0 1-0 25	Biliary obstruction hemolytic anemias Low in secondary anemia
CO_2 capacity (plasma) vol %	55 75‡	Respiratory diseases tetany Low in diabetes nephritis
CO_2 content (arterial blood) vol %	*45 55‡*	*Respiratory diseases tetany Low in diabetes* nephritis
CO_2 content (venous blood) vol %	50 60‡	Respiratory diseases tetany Low in diabetes nephritis
O_2 capacity vol %	16 24‡	Polycythemia anhydremia Low in cardiac and respiratory diseases anemia
O_2 content (arterial blood) vol %	15 23‡	Polycythemia anhydremia Low in cardiac and respiratory diseases anemia
O_2 content (venous blood) vol %	10 18‡	Polycythemia anhydremia Low in cardiac and respiratory diseases anemia
Ascorbic acid	0 8 2 4	Low in *scurvy*
Lactic acid	5 20	Exercise eclampsia
Phenols (free)	1 2	Intestinal obstruction pernicious anemia nephritis
Chlorides as NaCl	450 500	Nephritis cardiac conditions prostatic obstruction eclampsia anemia Low in diabetes, fever and pneumonia
Sulfates inorganic as S (serum)	0 9 1 1	*Nephritis*
Phosphorus inorganic as P (plasma)	3 4	Nephritis Low in rickets Normal values 1 2 mg higher in children
Calcium (serum)	9 0-11 5	Low in infantile tetany severe nephritis parathyroidectomy
Magnesium (serum)	1 3	No changes noted in disease
Sodium (serum)	330	Low in cases of alkali deficit
Potassium (serum)	*16 22*	*Pneumonia acute infections* occasionally in uremia
Iodine γ per 100 ml	8 15	Hyperthyroidism Low in cretinism

*From Hawk Oser and Summerson Physiological Chemistry ed 12 Philadelphia 1947 The Blakiston Company

†Figures express concentration in mg per 100 ml of whole blood unless otherwise indicated in the first column

‡Figures represent weighted averages of the observations of several investigators

clot, it separates into formed elements and serum, which is essentially plasma minus fibrinogen, the fibrinogen having been used up in the clot formation (see Clotting)

The erythrocytes or red cells are the hemoglobin containing, and therefore, the oxygen carrying, cells or corpuscles The leucocytes or white cells are the disease resisting cells The platelets participate in clot formation The red cells are the *heaviest portion of the blood and, therefore, appear after cen*trifugation as a thick, red, gelatinous mass in the bottom of the tube, while the white cells appear as a thin, creamy layer on top The platelets are not visible

The erythrocytes *vary in number in normal blood, depending* upon age, sex, geographic location, and the degree of activity and hydration of the individual Approximately 5 000,000 cells per cubic millimeter of blood is the average number for men, the number is slightly less for women The number present, as well as their physical structure, may be determined by microscopic examination (blood count), and these factors are of diagnostic value

The hemoglobin (Hb), a protein iron compound, is the red coloring matter of the red blood cells Human blood contains roughly 15 6 gm Hb per 100 c c The iron content of the hemoglobin gives to it the property of carrying oxygen without itself being oxidized If the percentage of hemoglobin or the total number of corpuscles *is below average in number, the oxygen* carrying capacity is affected and anemia results Hemoglobin unites with oxygen to form oxyhemoglobin, which is a brilliant red As blood leaves the lungs (arterial blood), it is bright red in color due to this oxygen content After circulation, with the removal of oxygen by the tissues and the uptake of carbon dioxide as a tissue waste product, the blood returns to the lung as dark red (or purplish) venous blood due to its low oxygen content its reduced hemoglobin In the lungs the carbon dioxide is expelled, oxygen is again taken up, and the blood starts on another trip around the body A drop of blood makes the complete circuit in about twenty seconds The average life of the red blood cell is from 110 to 130 days, therefore about 40 to 50 c c of blood *is destroyed and replaced daily*

Each 100 c c of normal plasma—and there are some 5 to 6 liters in the adult—contains 7 to 8 gm of protein Of this 60% is

serum albumin 35% is serum globulin and 5% is fibrinogen Traces of prothrombin are also present This protein fraction is of great importance

Whenever the proteins of the blood are appreciably decreased serious changes take place One of the functions of the blood proteins is to help control the water exchange between the blood vessels and the surrounding tissue When blood proteins fall fluid is lost into the tissues and edema or dropsy results "War edema" "prison dropsy" and "hunger swelling" all express the effect of protein restriction in the diet Protein deficiency occurs in severe hemorrhage with extensive burns in general peritonitis and in certain gastrointestinal tract disorders where protein utilization is impaired as well as when the dietary intake is inadequate Failure to maintain the normal concentration of the plasma proteins hence normal blood volume results in circulatory failure or "surgical shock" The value of transfusions of plasma in such conditions is well demonstrated by the countless lives saved since Pearl Harbor

Recently it has been found practicable to use commercially prepared amino acids or a protein digest when sufficient whole blood or plasma is not available or when higher concentrations of protein are immediately desirable Amigen (a mixture of amino acids and the smaller polypeptides made by enzymatic hydrolysis of casein and pork pancreas) is such a product Elman reports having successfully given as high as 400 gm of this product daily

It has been shown that for every gram of plasma protein lost 30 gm of dietary protein must be used for replacement Decreased plasma protein reflects tissue protein loss of a far greater extent This indicates the need for a high protein intake as replacement This is a matter to which blood donors especially those repeatedly giving blood should pay heed To replace the protein removed by the usual 500 c c donation requires approximately 100 to 120 gm of protein over and above the normal need Five hundred cubic centimeters of blood represents a loss of roughly 250 mg iron If all of the 12 mg recommended daily could be diverted to replacement which cannot be done it would take 21 days So the diet following blood donation should be directed toward restoration of iron as well as protein Vitamins of the B complex and vitamin C are also of importance

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Whole blood, by transfusion, is used *chiefly to replace blood loss* The red blood cells may be used to treat *or to prevent* anemia, except when the condition is due to blood *loss or infection* Plasma is used to prevent or to treat shock or in hypoproteinemia

Expressed as to *chemical composition*, the blood is made up of 75 to 80% water, 20% protein, 1 to 2% fat, 0 1% *glucose* about 2% inorganic salts—the sulfates, phosphates, *chlorides* and bicarbonates of calcium, sodium, potassium, and magnesium—and the nitrogenous substances—urea, uric acid, creatinine, creatine, and ammonia In addition, there are enzymes hormones, and immunizing agents

Clotting of Blood

The mechanism that prevents the complete outpouring of blood which would otherwise occur when a blood carrying vessel is cut is a complicated procedure in which many factors play a part By means of a chain of events, and the original presence of calcium salts and an antithrombin in the circulating blood the fibrinogen, which is in soluble form, becomes converted into an insoluble fibrin, a threadlike mass of protein, which enmeshes the blood cells and forms a clot Vitamin studies have revealed that another factor, vitamin K, is essential If this vitamin is absent from the blood stream, prothrombin (one of the intermediary substances) is not normally formed, the process of clot formation is interrupted, and the blood fails to clot with normal rapidity The coagulation or clotting time is prolonged Administration of vitamin K corrects the difficulty at once (see Chapter 11, Vitamin K)

Lymph

Blood is not the only liquid that transports material to different parts of the body The lymph, a form of blood serum, bathes all body tissues It is the fluid outside the blood vessels and around the body cells Lymph between organs and body walls is known as pleural or peritoneal fluid It is also spoken of as tissue fluid

Under pressure fluid seeps through the capillary walls into the outlying tissue—fluid in which minerals and protein are held in solution The water and minerals are able to reverse their direction and pass back into the capillaries Not so the protein,

unless it were picked up by the lymph it would be a nutritive loss, and too, protein accumulation outside the blood vessels would upset the osmotic pressure and water would likewise be retained causing edema The lymph absorbs the protein ladened filtrate and carries it along with the fat back to the blood stream via the thoracic duct.

There are no vessels corresponding to arteries in the lymphatic system, hence there is no real lymphatic circulation There are however, channels or tubes (the lymphatics) that begin in the open spaces between a capillary and a cell through which lymph flows slowly from all parts of the body toward the thorax where the greater part of the lymphatics which have been uniting again and again into ever larger tubes join in forming one big tube the thoracic duct This duct empties into the venous blood system at the junction of two large veins in the neck

Review Questions

1 Of what is blood composed?
2 What are its functions in the body?
3 What are the red cells of the blood called?
4 What is their function?
5 What are the white cells called?
6 What is their function?
7 What is the average number of red cells per cubic millimeter of blood?
8 What is hemoglobin? What function does it perform?
9 When the number of red cells or the percentage of hemoglobin falls below normal what is the result?
10 Why is the presence of protein important?
11 What is the importance of vitamin K in blood clotting?
12 What is lymph? How does it function?

CHAPTER 10

THE ENDOCRINES AND THEIR ROLE IN NUTRITION

While at first thought a discussion of the endocrines, those organs which secrete powerful regulatory substances into the blood, is outside the realm of nutrition, their hormones are important factors influencing the structural and nutritional condition of the body and should be mentioned briefly *They are discussed here for those who are interested*

In the early history of medicine various diseases were attributed to a lack of mysterious substances, supposed to be normally supplied by the various organs Treatment of such diseases consisted of an attempt to supply the lacking substance Opotherapy (organotherapy) was the name given to this type of treatment The brain of a hare was administered for nervousness and liver was given for disorders of the liver In 1849 Berthold described the effects of castration in a fowl He showed that implantation of testicular tissue could prevent the onset of the symptoms which follow this operation or could counteract the effect of the castration after these symptoms had appeared thus proving that there was a secretion produced by at least some of the organs which could cause widespread effects Borden, a physician at the court of Louis XV, believed that every organ in the body "is a workshop of a specific substance which passes into the blood " He thought that the physiological integration of the body depended upon these substances In 1889 Brown Séquard *treated general debility in himself by injections* of testicular extracts and reported highly beneficial results

The name **hormone** (excitor) was given to these secretions under the mistaken concept that they always had a stimulating action This is not always true, for the action of some hormones may be depressant or circumstances may determine just how the hormone may act (see Chapter 6, Digestion)

The known **organs of internal secretion** are the pituitary (or hypophysis) the pancreas, adrenals, thyroid, parathyroid, gonads (sex organs), and the intestines They all produce hormones.

The pineal and thymus glands may possibly belong to this list, although little is as yet known about their secretions The known hormones are specific and are powerful in their action

The Thyroid Gland

The believed functions of the thyroid gland are twofold it has an important effect on the growth and development of the body and it also has a stimulating effect on total metabolism

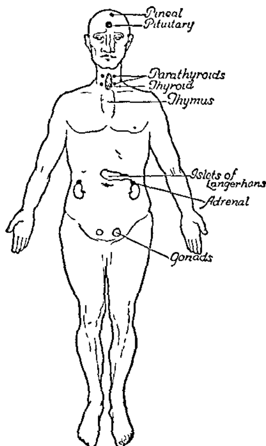


Fig 24 —Distribution of endocrine glands (From Williams Personal Hygiene Applied W B Saunders Co)

The thyroid gland is especially related to nutrition as its hormone contains more than half the iodine in the body This hormone is accepted by many as thyroxine, however, it has been suggested recently that thyroxine may not be the actual hormone of the thyroid gland The mother substance of thyroxine is the amino

acid tyrosine. Tyrosine has been proved to be one of the nonessential amino acids It can be readily synthesized in the body from the essential amino acid phenylalanine—a compound of similar structure. The reaction, however, is not reversible.

A **goiter** constitutes any enlargement of the thyroid gland (except those of an inflammatory or a malignant condition). A **simple goiter** usually develops when the hormone produced has a low iodine content. It has been suggested that this is due to low iodine content of the food eaten. In certain geographic areas, because of the low iodine content of the water and the soil, which is in turn reflected in the food. this type of goiter



A. B

Fig 25 —*A*, Case of myxedema *B*, same after seven months treatment (After Tigerstedt from Bard Macleod s Physiology in Modern Medicine)

(also known as colloid goiter) is endemic. The thyroid gland may grow to enormous size, up to 2 pounds or more in weight, probably as the result of an adaptive reaction. The gland attempts to compensate for the low quality of the secretion by excessive production This latent condition is precipitated frequently during periods of physical strain, such as adolescence or pregnancy

Marine, in his classical experiments with large groups of school children, has shown that the occasional administration of iodine to potentially goitrous children will prevent its de-

velopment in the large majority of cases. The commercially prepared iodized salt is a logical compensation for low food iodine especially in goiter belts and is of value in the prevention of simple goiter. However, in spite of the extensive use of iodine in these areas simple goiters have not completely disappeared. Thus it has been suggested that a low intake of iodine is not the single factor in bringing about this condition.



A B

Fig. 26.—Illustrating cretinism (A) and the recovery (B) after the administration of thyroid gland. (Nicholson.)

Hypothyroidism occurs when an insufficient amount of chemically normal thyroxine is produced and thrown into the blood stream. As a result the clinical condition called myxedema develops. The patient exhibits a characteristic vacuous expression, is slow of speech and shows general dullness of intellect. There is definite slowing up of all body processes including the metabolic rate which is, as would be expected, accompanied by

weight increase, unless dietary adjustment is made Where the deficiency existed at birth or soon after, cretinism develops Myxedema may arise after normal growth and development have taken place A *specific type of goiter may occur in relation to* this condition

Conversely, an overactive thyroid gland **(hyperthyroidism)**, with increased outpouring of thyroxine, causes an exophthalmic goiter The goiter is accompanied by bulging, staring eyes (exophthalmia), extreme nervousness, elevated pulse rate, and weight loss due to the increase in metabolic rate, which may be as great as +80 to 90% in severe cases

Parathyroid Glands

For a time the parathyroid glands were not clearly differentiated from the thyroid gland They are now known to have functions entirely distinct from the thyroid gland Accidental removal of the parathyroids during thyroidectomy has accounted for numerous cases of tetany (muscular spasm or convulsions) The secretion of the parathyroid glands exerts an effect upon smooth muscle by way of its control of the calcium blood level (see Chapter 13)

The Adrenals

The adrenals, also called suprarenals, one of which is at the upper side of each kidney, produce hormones which play important roles in the body processes Experimental studies reveal *the versatility of action of these secretions* The mammalian adrenal is made up of two parts, cortex and medulla Each part acts independently The cortex produces several hormones necessary for normal metabolism An extract of the cortex is known as cortin One of these hormones desoxycorticosterone, is involved in mineral metabolism and, in synthetic form, is used as medication in Addison's disease Occasionally, due to destructive lesions in the cortex, Addison's disease occurs (see Chapter 34) Characteristic of this condition are anemia, general languor, debility, feebleness of heart action, and peculiar bronzing of the skin The symptoms become progressively worse until, without other suffering, the patient dies The treatment or control, which is not entirely satisfactory, consists in the use of cortical extracts and drastic dietary adjustment in mineral in

take The sodium potassium levels of the blood are disturbed The sodium falls the potassium rises The diet therefore when one is prescribed is high in sodium and low in potassium

The medulla apparently is concerned in the control of neuro muscular activity Adrenaline (known also as epinephrine), secreted by the medulla stimulates glycogenolysis (glycogen breakdown into glucose) in the liver and the muscles so help ing to regulate the blood sugar level Adrenaline is probably formed from the amino acid tyrosine

The Pituitary

The pituitary (or hypophysis) consisting of two lobes is a small gland about the size of a large green pea situated at the base of the brain It produces secretions which have a definite effect on growth and development The pituitary gland is sometimes called the master gland The hormones from the anterior lobe control growth metabolism sex reactions and lac tation The secretions of the thyroid adrenal cortex and the gonads which are mutually interdependent for rates of activity are believed to be under the domination of the anterior pituitary Those of the posterior lobe govern blood vessel tone and urinary secretion Great advances have been made in the knowledge of the hormones of the anterior pituitary A number of these active principles have been extracted and purified The suggestion has arisen as a result of recent research that a fat metabolizing hor mone may also be secreted by the pituitary

If there is overactivity of the gland before puberty (which is itself a result of gonadal changes) too rapid structural growth takes place resulting in gigantism (Fig 27) When the hyper activity takes place during adult life acromegaly takes place

Underactivity or failure of the anterior lobe of the pituitary to develop normally results in the reverse condition dwarfism Another clinical manifestation of pituitary insufficiency is Simmonds disease in which extreme emaciation and premature aging result

The Pancreas

The pancreas the long slender organ lying in the bend of the small intestine just below the pylorus produces both an in ternal and an external secretion The external secretion (pan

creatic juice) is discussed in Chapter 6, Digestion It is with the internal secretion, insulin, that we are here concerned Insulin, produced by the islet cells (the islands of Langerhans, so named for their discoverer), controls carbohydrate metabolism An inadequacy of insulin results in incomplete oxidation of carbohydrates, high blood sugar, and excretion of sugar in urine, and disturbance in fat utilization (see Chapter 6, The Fats) The condition which results is known clinically as diabetes mellitus This is sometimes spoken of by the laity as "sugar diabetes" The possibility exists that other glands may be involved in this condition.

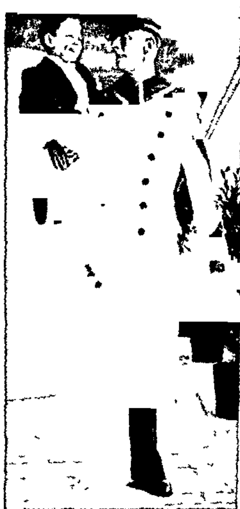


Fig 27 —Giants and dwarfs owe their abnormal stature to the overactivity or underactivity of the pituitary gland (Courtesy Press Association Inc New York)

A combination of diet adjustment and hypodermic use of sufficient insulin prepared from animal tissue can compensate for the individual's discrepancy in insulin production control the clinical condition and return the individual to a state of health in which he can carry on normal activities

When excessive amounts of insulin are produced and secreted abnormally rapid combustion of carbohydrate ensues and the blood sugar is held at a level below normal Clinically this condition is known as hyperinsulinism or hypoglycemia Dietary adjustment is essential in this condition also

The Gonads

The gonads sex glands (testes ovaries and their auxiliary structures) determine and control sex characteristics To a slight extent they also influence the metabolic rate As sexual activity slows down so does the metabolic rate Here again overactivity and underactivity of the glands result in definite body changes The sex hormones are being actively studied today and far reaching results may yet be attributed to them

As might be expected since all hormones are blood borne their influence is widespread and abnormalities in any gland can produce abnormalities in other glands until complicated clinical conditions and metabolic dysfunction may result Wiggers in discussing the interplay of the hormones of the endocrine organs writes No single hormone or endocrine gland acts wholly by itself at any time the effects are always produced through an interplay of several This interplay of the endocrine ensemble controls to a significant extent (a) metabolism (b) growth and development (c) sex functions and reproduction Consequently it proves didactically expedient to orient oneself with the general ways in which these interacting hormones modify these functions '

creatic juice) is discussed in Chapter 6, Digestion. It is with the internal secretion, insulin, that we are here concerned. Insulin, produced by the islet cells (the islands of Langerhans, so named for their discoverer), controls carbohydrate metabolism. An inadequacy of insulin results in incomplete oxidation of carbohy-

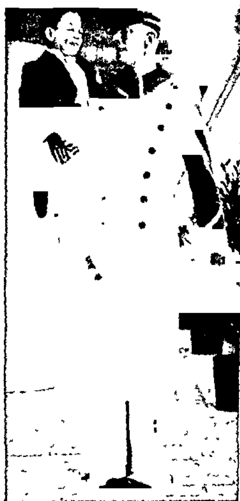


Fig 27—Giants and dwarfs owe their abnormal stature to the overactivity or underactivity of the pituitary gland (Courtesy Press Association, Inc., New York)

drates, high blood sugar, and excretion of sugar in urine, and disturbance in fat utilization (see Chapter 6, The Fats). The condition which results is known clinically as diabetes mellitus. This is sometimes spoken of by the laity as "sugar diabetes." The possibility exists that other glands may be involved in this condition.

A combination of diet adjustment and hypodermic use of sufficient insulin prepared from animal tissue can compensate for the individual's discrepancy in insulin production, control the clinical condition, and return the individual to a state of health in which he can carry on normal activities.

When excessive amounts of insulin are produced and secreted, abnormally rapid combustion of carbohydrate ensues and the blood sugar is held at a level below normal. Clinically this condition is known as hyperinsulinism or hypoglycemia. Dietary adjustment is essential in this condition also.

The Gonads

The gonads, sex glands (testes, ovaries, and their auxiliary structures), determine and control sex characteristics. To a slight extent they also influence the metabolic rate. As sexual activity slows down, so does the metabolic rate. Here again overactivity and underactivity of the glands result in definite body changes. The sex hormones are being actively studied today and far-reaching results may yet be attributed to them.

As might be expected, since all hormones are blood-borne, their influence is widespread, and abnormalities in any gland can produce abnormalities in other glands until complicated clinical conditions and metabolic dysfunction may result. Wiggers, in discussing the interplay of the hormones of the endocrine organs, writes: "No single hormone or endocrine gland acts wholly by itself at any time; the effects are always produced through an interplay of several. . . . This interplay of the endocrine ensemble controls to a significant extent (a) metabolism, (b) growth and development, (c) sex functions and reproduction. Consequently it proves didactically expedient to orient oneself with the general ways in which these interacting hormones modify these functions."

CHAPTER 11

THE FAT-SOLUBLE VITAMINS

It was not until the second decade of the twentieth century that previously unknown substances were identified as vitamins. Since that time, many have been isolated and studied. Vitamins are usually classified according to solubility, i.e., fat soluble and water soluble. The fat soluble vitamins designated are A, D, E, and K. Each serves the individual in characteristic fashion and is also necessary for normal nutrition and health. To date, deficiency diseases are known for vitamins A and D. Generally speaking, the fat soluble vitamins may be stored in the body.

Mankind has long known that certain diseases could be cured by specific foods. As mentioned earlier, centuries ago Hippocrates (500 B.C.), the Father of Medicine, prescribed the liver of the ox dipped in honey as a cure for night blindness. Three centuries ago Cartier described an outbreak of sickness (later known to be scurvy) cured by the "juice and sappe of the leaves of a certain tree." Two hundred years ago Lind proved that the inclusion of a "lime" each day in the diet of the sailors in the English navy prevented the terrific death toll of scurvy. Fifty years ago Takaki found that the beriberi afflicting the Japanese sailors could be cured by adding meat, vegetables, and milk to the polished rice diet then in use.

Magendie (1783-1855) first described an experimentally produced disease by showing that guinea pigs could not survive if fed on a single foodstuff, and that on a fixture of foods health could be maintained. He wrote, "Variety in the diet is an important aid to health." Oliver Wendell Holmes expressed this thought in the *Mind's Diet*—

> "No life worth naming ever comes to good
> If always nourished on the selfsame food,
> The creeping mite may live so if he please,
> *And feed on Stilton till he turns to cheese,*
> But Carl Magendie proves beyond a doubt,
> If mammals try it, that their eyes drop out."

The last line refers to the true vitamin A deficiency which Magendie produced and described

Lunin in 1881 fed mice on mixtures of artificial foodstuffs and found that for life "a natural food such as milk" must always be included

Pekelharing (1905) likewise concluded that milk contained an unknown substance of paramount importance to nutrition

In 1912 Hopkins proved beyond doubt that synthetic diets were not adequate for life So clearly did he summarize his data and the data of others that he is credited with being the first to demonstrate conclusively the existence of a vitamin

In 1912 Funk suggested that the name vitamine be given to these hitherto unnamed substances because he thought they were vital amines This theory has since been disproved and the final *e* has been dropped from the term It has been shown that vitamins represent a variety of chemical substances their only common characteristic being that they they function in minute traces and if absent from a diet specific *deficiency diseases* ensue In the strict sense of the term a deficiency disease may arise from the lack of any dietary essential protein mineral fat vitamins or other constituents However in popular usage the term has come to be more or less specific for the conditions developing as the result of vitamin lacks If a vitamin is completely lacking a condition of avitaminosis results if the deficiency is in amount the condition is of *hypovitaminosis* Subclinical deficiencies (hypovitaminoses) exist and are responsible for some forms of the vague ill health which prevail today

Vitamins were originally named according to the letters of the alphabet and grouped under the two headings fat soluble and water soluble vitamins but as their chemical structures are becoming known these letters are being replaced by correct chemical designations which indicate their widely varying chemical structure

Certain definite vitamin deficiency diseases are well recognized xerophthalmia (A) beriberi (B) scurvy (C) pellagra (niacin) and rickets (D) sterility in certain animals (E) bleeding due to lack of clotting (K) and other less specific conditions All respond with rapidity to vitamin therapy

In general the well balanced diet which includes milk egg meat cereal fruit vegetable and animal fat adequately supplies

all the necessary vitamins At times the need is increased, as in pregnancy, lactation, convalescence, and when the metabolic rate is elevated as in fevers and hyperthyroidism At other times the increased need arises from faulty absorption of fat soluble vitamins A, D, E, and K, due to inability to absorb fat normally There may be increased need faulty absorption, or destruction as in cases of gastrointestinal tract disturbances, or a "constitutional inefficiency" may be present When such conditions exist, the vitamin intake must be adjusted carefully or commercial vitamin products must be employed

The present widespread use of commercial vitamin products and self medication with them have assumed alarming proportions Unfortunately, their sales constitute one of the most important items on the drug list Too many of them have not been prescribed by a physician These commercial vitamins, it must be remembered, are drugs and should be considered as such

Vitamin research is an active field and has progressed to the point that it is possible not only to isolate pure vitamins from food products but to synthesize them as well The vitamin is no longer a vague, elusive something It is a definite entity The synthesis of vitamins B_1 (thiamine), B_2 (riboflavin), B_6 (pyridoxine), nicotinic acid pantothenic acid, choline, para aminobenzoic acid, folic acid B_{12} and biotin (members of the vitamin B complex), of C, D, and K, has been accomplished

Vitamins were discovered through animal experimentation Synthetic diets containing various food combinations fed to experimental animals made apparent one deficiency after another Chemists kept pace with the research worker and rapidly isolated the vitamin determined its chemical structure, and then synthesized the factor involved Once the chemical structure is determined, methods for chemical detection are found and the assay of various foods to determine their vitamin content becomes possible It is also possible to determine the amount of vitamin in the blood, urine, spinal fluids, and tissues as a means of measuring the body tissue saturation point for various vitamins Human studies involving these latter determinations have yielded approximate standards for calculating the dietary intake If for example, on a generous intake of a specific vitamin a nearly constant amount is retained by the body each day, as evidenced by the difference between intake and excreted

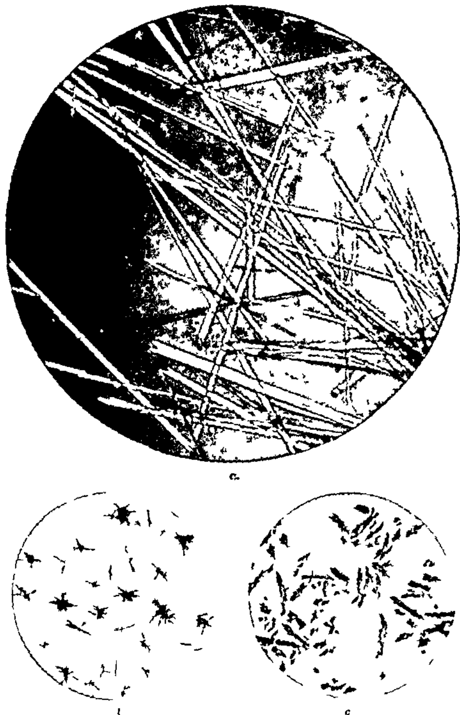


Fig 28.—The crystalline vitamins (collected from various sources) *a* The yellow crystals of vitamin A *b* thiamine chloride (B_1) *c* riboflavin (B_2) (*a* From Have You Had Your Vitamins? by Harry N Holmes copyright 1938 and reproduced by permission of Farrar and Rinehart Inc Publishers *b* and *c* courtesy of Abbott Laboratories North Chicago)

amounts, one may reasonably assume that amount to be the daily utilization or recommended intake.

The earlier vitamin studies were concerned with deficiency diseases and curative measures. More recently, however, attention has turned to the specific function of the vitamins—their physiological action in the body and the possible interrelationship of enzymes, hormones, and vitamins. As a result, data regarding the exact mechanism of vitamin activity are accumulating.

With the availability of the crystalline products, progress has been made in the clinical application of vitamin therapy, and methods for detection of deficiencies are becoming more exact. Dr. Jolliffe has stated that "Nutritional inadequacy starts the instant that adequate amounts of any essential nutrient fail to reach the internal environment." He lists the stages of progressive deficiency as: (1) tissue depletion; (2) biochemical "lesions"; (3) altered function, and (4) anatomical lesions They are clinically recognized, however, in reverse order.

The ability to determine vitamin values chemically has made many detailed studies possible which would not have been possible by the older methods of bio-assay (animal feeding experimentation). Formerly, the vitamin assay of any substance required weeks of laborious animal feeding work. Today these same values for most of the vitamins can be obtained within a matter of hours. It will be remembered that a deficiency of any vitamin results in a slowing up of the growth rate. *Animals grow normally, have good muscular development, well-formed teeth and bones, bright clear eyes, and sleek soft hair only when the diet is adequate in all respects.*

Two additional currently interesting and important phases of vitamin knowledge should be noted. One is biosynthesis, and the other the antivitamins.

Biosynthesis is the formation of vitamins within the animal body. This is a new and important finding, since the original definition of the term vitamin includes the idea of "essential substances which must be provided in the diet because the body has been unable to manufacture them." Now it seems some vitamin synthesis can take place in the intestinal tract under the influence of bacteria—a fact brought to light by the use of the sulfonamides and their destructive action on bacteria.

Twenty five years ago it was noted that experimental animals who had access to their own feces did not respond as did those who had not It was suggested this was due to vitamins present in the feces This curative effect was called refection The extent to which this is possible is variable with animals and the various vitamins

For the present its practical application is an appreciation that it may influence human needs, and that when sulfonamides are given, or any drug, which decrease bacterial action, these may decrease the body's own production of vitamins and so unexpectedly result in deficiency It indicates the need of high vitamin intake at such times Research is active on this subject

The other interesting finding is the existence of **antivitamins** Not only are there antivitamins but antihormones as well Isolated facts that had no explanation have gradually been pieced together, until today it is realized that substances very similar to the vitamins exist and that they have neutralizing effect Apparently the two compete for the same place in the tissue One, the vitamin, is biologically active and permits normal function The other is not and when it replaces the vitamin, or exceeds it in amount normal tissue function is hampered It answers the question of why para aminobenzoic acid could offset the effect of the sulfonamides why high corn intake is a factor in pellagra, why feeding of raw fish to certain animals results in thiamine deficiency Research has progressed to a point where antivitamins have been found for thiamine, riboflavin, pantothenic acid, para aminobenzoic biotin ascorbic acid, vitamin K, inositol, and folacin (folic acid)

These findings undoubtedly will have far reaching effects The requirement values may need alteration, the vitamin values of food may need correction for antivitamin content, to express net vitamin content rather than total It may be possible to produce deficiency states through administration of excessive amounts of antivitamin which may alter our present concepts It is complicated, and until the scientist has more time to unravel the mysteries of it we may continue as before in our thinking and practice

Today there are more than thirty vitamins known to man In some cases, extensive information has been obtained concerning

the function, requirement, interrelationships, and sources of some of the vitamins However, much remains to be determined and it is anticipated that unknown vitamins will be discovered as well as additional information offered about those already identified

A consideration of the vitamins traditionally divides them into two groups according to their basic chemical property solubility They may be fat soluble or water soluble The vitamins discussed in this chapter are known as the fat soluble ones and those found in Chapter 12 are water soluble

Vitamin A

Until 1913 it was believed that all fats had similar nutritive value In 1913 however McCollum and Davis and Osborne and Mendel, demonstrated independently that certain fats had in addition to calories some factor necessary in the prevention of an eye disorder occurring in rats Other fats did not have this protective ingredient Further, rats could be stunted in growth and misshapen when certain fats were withheld Cod liver oil was found to be an extremely potent protective oil Animal fats in general were protective, the vegetable fats were not To the factor which was responsible for the protective action the name vitamin A was given

In 1922 McCollum showed that vitamin A was actually two vitamins one protective against eye disorders (antiophthalmic or antixerophthalmic), the other protective against bone abnormalities (antirachitic) The first fraction retained the designation *vitamin A and the second became known as* vitamin D McCollum discovered this duality by recognizing that cod liver oil which cured the dryness of the eye and rickets before the oil was treated with hot air ceased to protect against xerophthalmia but continued to cure rickets after the treatment with the stream of hot air He also realized that certain foods were protective against xerophthalmia and not against rickets, and the reverse Mellanby in England showed essentially the same results and hence since 1923 the antirachitic fraction has been known as vitamin D

Vitamin A exists in two forms—as A_1 found in livers of salt water fish and as A_2 in the livers of fresh water fish Vitamin A as such does not occur in the vegetable kingdom It exists rather as the precursor or mother substance—the carotenes or caroten

oids Carotene is converted into vitamin A in the intestinal wall of the animal body. Conversion must take place before the vitamin is physiologically available to the animal As might be expected in this reaction, loss occurs Actually, the vitamin value of carotene is but approximately one-half that of vitamin A.



Fig 29 — Xerophthalmia The child is suffering from severe xerophthalmia due to a diet consisting largely of skim milk and cereals At the time this picture was taken (1917) there were many such cases in Denmark due to the war ration (Photograph of a baby from the practice of Dr C. E Block of Copenhagen)

When data for vitamin content are expressed as carotene, this fact must be kept in mind It is estimated that two-thirds of the vitamin A content of the average American diet is obtained from carotene and related compounds, whereas one-third is derived as the preformed vitamin

Vitamin A is fat soluble, stable to heat, acids, and alkalies, but is destroyed by light and is sensitive to oxidation especially in the presence of rancid fat. Recently, vitamin E has been used to prevent the oxidation of vitamin A since vitamin E has been found to have antioxidant properties. In general, it has been suggested that the provitamin is less well utilized than is vitamin A and that it is likely to be destroyed by oxidation in the intestinal tract.

Animals and human beings deprived of adequate vitamin A for a matter of weeks begin to show eye changes and impaired vision. At first there is inability to make light dark adaptation with the sudden change from dark to light, a condition which is commonly called night blindness. The cause is lack of adequate vitamin A in the retina. The enzyme which functions in this regeneration of the visual purple is coenzyme I which is formed from niacin, one of the B complex vitamins (see Chapter 12). The degree of vitamin lack can be measured by a machine known as a biophotometer. As the deficiency becomes more marked, eye changes increase. Concurrent with eye changes is a cessation of growth, a condition which has resulted in vitamin A being called a growth promoting vitamin, which it is. The alteration of growth rate is due to the fact that vitamin A is an essential stimulus for cell formation. This action suggests the value of high vitamin intake in wound healing.

In extreme deficiency, skin changes as illustrated in Fig. 30 may result. The skin becomes dry, normal sweat glands actually are absent, the skin is inelastic, is dull gray in color, and on scratching produces a white, powdery desquamation. Cases reported are said to respond to high vitamin therapy in a few weeks. A relationship between hair loss and brittleness of fingernails and vitamin A intake has been suggested.

Severe vitamin A deficiencies are rare today, but mild deficiency is fairly prevalent. Inadequate intake of animal fat and the highly colored vegetables, or faulty fat absorption will result in such deficiency. Changes in the epithelial tissues are apparent in the eye and also take place in the genitourinary tract and the respiratory system. Predisposition to infection results from the lowered resistance of the altered tissues. It does not follow, however, that one can increase resistance by attempting to overstock the body with vitamin A. This vitamin is anti

infective only when added intake raises a suboptimal level to a normal one Vitamin A is also necessary for normal reproduction and for lactation in rats

Fortunately vitamin A can be stored for long periods of time in the body tissues This is not true of all vitamins Approximately *nine tenths of the stored material is in the liver*

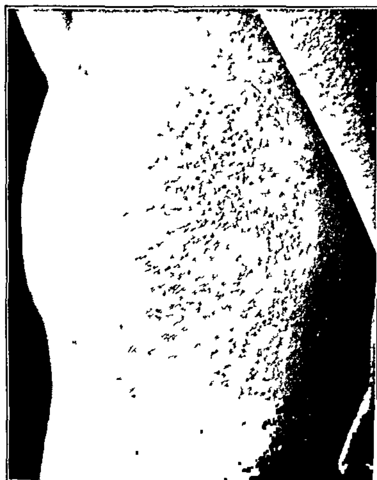


Fig 30—Cutaneous lesions in vitamin A deficiency showing generalized xeroderma and follicular hyperkeratosis in a Chinese patient with xerophthalmia before halibut liver oil therapy had been given (Courtesy Dr Chester N Frazier from Sutton and Sutton An Introduction to Dermatology)

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FOODS AS SOURCES OF VITAMIN A

Green, leafy and yellow vegetables are outstanding sources. Dairy products, eggs and liver (and fish liver oils) are the important animal sources. Vitamin A is well conserved in cooking . . . . .

CONTRIBUTION OF SELECTED SERVINGS OF A FEW FOODS AS PERCENTAGES OF ADULT MALE ALLOWANCE (5000 INTERNATIONAL UNITS (I.U.))

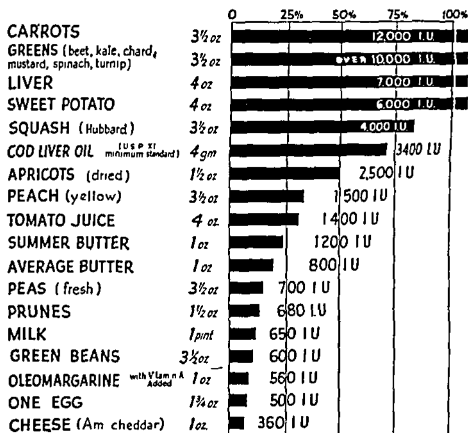


Fig 31 —This table was prepared by a joint Committee of the Council on Foods and Nutrition of the American Medical Association and the Food and Nutrition Board of the National Research Council It is reproduced by permission

be converted into vitamin A in the animal body. It is a precursor or mother substance of vitamin A and is called provitamin A. It has been estimated that the average vitamin A content of the liver may be from 200 to 400 I U per gram. The mechanism whereby vitamin A is mobilized from this reserve store is unknown.

Vitamin A is expressed in terms of International Units (I U). In 1949 a new international standard was established by the Subcommittee on Fat-soluble Vitamins of the World Health Organization. Using the new standard, the International Unit is equal to 0.344 microgram of vitamin A acetate or 0.30 microgram of the alcohol and makes 0.6 microgram of beta carotene the unit for the provitamin. It is of interest to note that even in a nutrient known as long as vitamin A, such basic changes as adopting a new international standard may be made as a result of current research. Nutrition is not a static science.

TABLE 21

RECOMMENDED DAILY DIETARY ALLOWANCES FOR VITAMIN A

Food and Nutrition Board, National Research Council, Revised 1953

	AGE YR	WEIGHT KG	(LB)	HEIGHT CM	(IN)	VITAMIN A I U
Men	25	65	(143)	170	(67)	5 000
	45	65	(143)	170	(67)	5 000
	65	65	(143)	170	(67)	5 000
Women	25	55	(121)	157	(62)	5 000
	45	55	(121)	157	(62)	5 000
	65	55	(121)	157	(62)	5 000
	Pregnant (3rd trimester)					6 000
	Lactating (850 ml daily)					8 000
Infants	0–1/12*					
	1/12–3/12	6	(13)	60	(24)	1 500
	4/12–9/12	9	(20)	70	(28)	1 500
	10/12–1	10	(22)	75	(30)	1 500
Children	1–3	12	(27)	87	(34)	2 000
	4–6	18	(40)	109	(43)	2 500
	7–9	27	(59)	129	(51)	3 500
Boys	10–12	35	(78)	144	(57)	4 500
	13–15	49	(108)	163	(64)	5 000
	16–20	63	(139)	175	(69)	5 000
Girls	10–12	36	(79)	144	(57)	4 500
	13–15	49	(108)	160	(63)	5 000
	16–20	54	(120)	162	(64)	5 000

*See Table 3 for explanatory footnote

Table 21 indicates the Recommended Daily Allowances for Vitamin A The National Research Council* points out that the requirement for vitamin A appears to be proportional to body weight, thus levels of intake which provide 20 I U (6 micro grams) of preformed *vitamin A per kilogram of body weight* or 40 I U (24 micrograms) of beta carotene have been demon strated to meet minimal requirements The allowance has been calculated on the basis of an intake approximately double that of meeting minimal requirements to provide for the maintenance of good nutrition in the total population

Vitamin A and carotene are abundantly supplied by cream butter, margarine, milk, highly colored fruits, vegetables, liver, egg yolk, and salmon The vitamin A value of fruits and vege tables is directly proportional to the intensity of color, that is, the deeper the green or yellow, the higher the vitamin content It has been shown that the deep green outer leaves of lettuce are richer in vitamin A than the paler inner leaves from the same head Also, as indicated previously, there seems to be a varia tion in availability of the carotenoids in food which relates to other constituents of the diet Thus, a diet containing a pint of milk, a serving of butter or fortified margarine, a green, leafy, or yellow vegetable, and fruit, in addition to a protein such as cheese egg, liver, or dark colored fish, meets the recommended allowance for vitamin A of the normal individual

Vitamin D

Like xerophthalmia and other deficiency diseases (see Chapter 12), the disease rickets has been known for centuries In 1650 Francis Glisson wrote a classical discussion of the subject In 1922 McCollum showed rickets could be cured or prevented by the addition of certain oils to the diet The minerals calcium and phosphorus are also factors involved in the occurrence or prevention of rickets (see Minerals, Chapter 13) For normal bone tooth formation, calcium, phosphorus, and vitamin D must be present in proper proportions

In 1919 it was shown that light rays could heal rickets, the rays from the sun itself or the artificially produced ultraviolet ray In 1924 it was demonstrated that food could be irradiated by the ultraviolet ray and thereby become capable of curing

*National Research Council Bulletin No 302 p 13

rickets What power has the sunlight ray? The discovery was made that vegetable and animal tissues (body skin) contain a lipid fraction itself inactive but which could be made active by the ultraviolet ray Ergosterol in grain and a sterol in animal tissue are precursors of vitamin D or provitamin D This fact has led to the irradiation of cereals milk etc, and the use of sunlight both natural and in the form of rays from sun lamps

In 1930 crystalline vitamin D was isolated from crude irradiation products of ergosterol and was given the name calciferol It has a potency of 40 000 U S P units per gram It is now known that ten vitamins D (D_1 D D_3 etc) exist They all have slightly different formulas and are not equally antirachitic



Fig 3 —Rickets following a diet of 175 c c of whole milk white bread ad lib and 10 c c of linseed oil per day Time of experiment five and one half months Increase in weight during period of experiment 2 670 gm (Courtesy Controller of H M Stationery Office from Medical Research Council Report No 16)

Calciferol obtained from irradiation of ergosterol is vitamin D_2 ($C_{28}H_{43}OH$) Commercially dissolved in oil it is known as viosterol From irradiated animal sterol vitamin D_3 7 dehydrocholesterol ($C_{27}H_{43}OH$) is obtained Commercially it is known as *Delesterol when dissolved in oil*

Since it is a fat soluble vitamin ingested vitamin D is absorbed with the fat of food Thus any condition that interferes with the absorption of fat will in turn interfere with the absorption of vitamin D It is stored primarily in the liver and

that values as high as 400 units per quart may be obtained by irradiation Reinforced or fortified milk contains 400 units per quart Some margarine is fortified with vitamin D

Vitamin E—Alpha Tocopherol, $C_{29}H_{50}O_2$

As early as 1920 Mattill and Conklin found that rats reared on cow's milk were incapable of raising young, even though the milk, as they thought, was adequately supplemented to make an adequate diet Two years later Evans and Bishop reported that for normal reproduction *a definite dietary factor was necessary* This factor, first designated vitamin X and later changed to vitamin E, is now known to be alpha tocopherol, an alcohol having the formula $C_{29}H_{50}O_2$ The name signifies its role—*tokos* meaning childbirth, *phero* meaning to bear, and *ol* meaning an alcohol Actually four tocopherols exist alpha, beta, gamma, and delta These differ slightly chemically and in biological activity The alpha is the most potent biologically

More than a quarter century has passed since the existence of vitamin E was definitely established Its first recognized function as an antisterility factor for the laboratory rat has been overshadowed by its demonstrated need for maintenance of structural and functional integrity of skeletal, cardiac, and smooth muscle, and, in some animals, the peripheral vascular system Tocopherols play an important role as intracellular antioxidants, related especially to the stabilization of ingested fats and possibly of products arising in the metabolic synthesis and degradation of lipids They may also function in a detoxifying capacity Morphological alterations arising in the course of vitamin E deficiency may well represent localized reactions of particularly susceptible tissues to loss of these vital antioxidants or secondarily to dysfunction of enzyme systems in which tocopherols actively participate

The histopathological lesions of E deficiency are remarkably varied, they represent morphological alterations in a number of unrelated tissues They seem not to be related to dysfunction of any specific type of cell or tissue and they are of such a nature that restoration of normal morphology rarely occurs after tocopherol therapy, even though the physiological or biochemical disturbances are corrected Most lesions are dependent upon

fat in the diet and their onset and intensity are accentuated in proportion to the amount and degree of unsaturation of the fat used. There are the possibilities that the unsaturated fats destroy dietary traces of the vitamin in the diet or the intestinal tract. They or their oxidation may produce a direct cell injury which is superimposed upon that due to a lack of vitamin E. Excess utilization of tocopherols to stabilize unsaturated fats being incorporated into cell lipids hastens depletion of tissue tocopherols and the precipitation of deficiency manifestations.



Fig. 34.—A [illegible] month old rat showing paralysis due to vitamin E deficiency. (Courtesy of Dr. G. O. Burr, University of Minnesota, and Hawley and Maurer-Mast, The Fundamentals of Nutrition, Charles C Thomas, Publisher.)

Conceivably the true picture may represent a combination of these postulated interactions. With these possible interactions in mind the symptomatology and histopathology of *experimental* vitamin E deficiency may be more comprehensible.

Little is known concerning the requirement of man for vitamin E. On the basis of present knowledge a deficiency symptom in man cannot be set forth. However, as described by Putt, this does not mean that a relationship of vitamin E *to requirement*

TABLE 23

VITAMIN E CONTENT OF FOODS*

	TOTAL TOCOPHEROLS MG/100 GM FRESH FOOD
VEGETABLES	
Beans, dried navy	3 6
Cabbage	0 11
Carrots	0 45
Celery	0 48
Lettuce, iceberg, 1	0 54
2	0 68
† 3	0 43
Onions	0 26
Peas, green	2 1
Potatoes, peeled	0 06
Potato peels	1 8
Tomatoes	0 36
Turnip greens	2 3
CEREALS	
Cornmeal, yellow	1 7
Oatmeal	2 1
Rice, brown	2 4
Rice, polished	0 57
Wheat products	
Bread, white	0 23
Bread, whole wheat	1 3
Crackers, soda	3 7
Farina	1 6
Flour, white (80% extraction)	1 2
Flour, whole wheat	2 2
Spaghetti	1 2
MEAT, FISH, POULTRY, AND DAIRY PRODUCTS	
Bacon	0 53
†Beef, dehydrated	
Beefsteak	0 63
Lamb chops	0 77
Pork chops	0 71
Fish (haddock)	0 39
Chicken	0 25
Eggs (whole)	2 0
Butter	2 4
Cheese American	1 0
Milk, fresh	0 12
Milk, evaporated	0 30
FRUITS	
Apples	0 74
Bananas	0 40
Grapefruit	0 26
Oranges	0 24

*We are indebted to Dr Philip Harris of Distillation Products Inc Rochester for this table of food values

†Bio assayed

TABLE 23—CONT'D

	TOTAL TOCOPHEROLS MG /100 GM FRESH FOOD
FATS AND OILS	
Cottonseed oil, refined	90
Corn oil, refined	87
Lard	2 7
†*Margarine, clarified*	54
Olive oil	6 9
Soybean oil, refined	140
MISCELLANEOUS	
Apple pie 1	0 20
2	2 2
3	0 29
Chocolate, unsweetened	11 1
Peanuts	9 3

and disease in man will not be established It simply indicates that, so far, none has been determined

The vitamin is distributed in nature in the oils of seeds and grains, such as cotton rice or corn wheat germ, and wheat germ oil Leafy green vegetables and to a lesser extent eggs and meat, are sources of the vitamin Deficiency is probably rare The Rochester workers* have calculated the vitamin E intake in typical diets for health and disease and include that the average American appears to receive about 15 mg tocopherols daily against a calculated requirement of 25 mg They state "One important fact emerges namely the important place that vegetable fat, exemplified by margarine occupies as a source of vitamin E"

The needs during pregnancy are tentatively set at 50 mg daily

Synthetic tocopherol (as the acetate) and "concentrates" obtained by distillation are now available Expression of potency of these products is on a milligram basis

Vitamin K—Menadione

Vitamin K, the coagulation (koagulation) or prothrombinogenic factor, is another vitamin belonging to the fat soluble group

*Hickman K C D and Harris P I Tocopherol Interrelationships Advances in Enzymology New York 1946 Interscience Publishers Inc Vol 6 p 469

It was discovered by Dam (a Dane) in 1929 while he was studying cholesterol metabolism in hens He observed a peculiar hemorrhagic disease, characterized by a prolonged bleeding time, with some symptoms of scurvy In 1935 this was shown to be a dietary deficiency disease Later (in 1936) Dam and his co workers found this hemorrhagic condition to be due to a decrease in blood prothrombin

Fatal hemorrhages have been known to occur in the newborn infant at about the third day of life, and experimental work, given impetus by the discovery of vitamin K, has shown that these infants had a prolonged clotting time It is now known that this prolonged clotting time can be restored to normal by a single dose of 1 mg of synthetic vitamin K given to the mother before delivery This single dose will also carry the infant over the critical period In order to aid in the prevention of the brain hemorrhage at birth, it has been suggested that a daily oral dose of 1 mg of vitamin K be given to pregnant women during the last month of pregnancy Hemorrhages due to hemophilia, however, are not corrected by this vitamin inasmuch as the prothrombin of the blood in this condition is not below normal

The mechanism whereby vitamin K takes part in the production of prothrombin is unknown Vitamin K is synthesized by microorganisms in the intestinal tract It is absorbed from the intestine only in the presence of bile Therefore, any condition which might interfere with the flow of bile may prevent the absorption of vitamin K from foods or from that synthesized in the intestine

It is extremely difficult to produce a deficiency of vitamin K by dietary restriction The diet normally supplies adequate amounts as the vitamin is found in most leafy green vegetables hemp seed, soybean oil, rice bran, and egg yolk Other rich sources are alfalfa, kale, spinach, dried carrot top, tomatoes putrefied fish meal, and casein

Vitamin K is available commercially in two forms, in an oil prepared from alfalfa, and as a synthetic crystalline product, either oil soluble or water soluble There are several vitamins or substances with vitamin K activity—K_1 ($C_{31}H_{46}O_2$), K_2 ($C_{41}H_{56}O$), and others Potency of the synthetic product, which has been named menadione, is expressed on a milligram basis. For the natural product several units are used The chick units

TABLE 21

FAT SOLUBLE VITAMINS—THEIR FUNCTIONS AND IMPORTANT SOURCES

VITAMINS	FUNCTION	DEFICIENCY SYMPTOMS	PRIMARY SOURCES
Vitamin A	Essential for growth *Essential for structure and functioning of cells of skin and mucous membranes* Aids in tooth and bone formation Aids body to resist infection Aids eyes to adjust to changes from bright to dim light	Retarded growth *Characteristic changes in skin and membrane* Night blindness Lowered resistance to infection	Fish liver oils *Liver* Yellow, and dark green leafy vegetables Yellow fruits Cream Butter Fortified margarine Whole milk
Vitamin D	Essential for growth Essential for regulation of calcium and phosphorus in bone and tooth formation Essential for regulating calcium and phosphorus metabolism Aids in absorption of calcium from the intestinal tract	Retarded growth Rickets Poor tooth and bone formation	Sunlight Fish liver oils Fatty fishes Fortified margarine Fortified milk
Vitamin E	Specific function for man unknown Acts as antioxidant for some vitamins, and unsaturated fatty acids Essential for normal reproduction of many animals	Undetermined	Wheat germ oil Cottonseed oil Corn oil Soybean oil Margarine Butter Navy beans Green leafy vegetables
Vitamin K	Essential for normal clotting of blood	Hemorrhages	Green leafy vegetables Pork liver Soybean oil Seeds Fruits Root vegetables

established on the basis of the effect of the vitamin on chicks, are named after Dam, Ansbacher, or Almquist

Dicumarol, the antivitamin of vitamin K, causes a decrease in clotting time This has been useful clinically to prevent the formation of thrombi It has been difficult to control and severe hemorrhage could occur However, recently, methods have been developed whereby the effect of Dicumarol may be quickly negated

One other point rightfully should be discussed under the fat soluble vitamins This is the use of mineral oil **Mineral oil** has been widely used and accepted as a mild purgative The pros and cons of its value have no place here but its effect on the absorption of the fat soluble vitamins has Its ingestion seriously interferes with the utilization of carotene, vitamins A, D, E, and K—the fat soluble group These are absorbed by the oil and leave the body without being released from it, thereby resulting in possible deficiency

Review Questions

1 What were some of the early observations concerning the existence of food elements other than proteins, fats, and carbohydrates? Who were the scientists concerned with these demonstrations and when did these experiments take place?
2 Who named these elements vitamines, and why was this name chosen?
3 Before their chemical structures were determined, how were vitamins designated?
4 What are some of the recent interesting discoveries related to vitamins?
5 What should the human dietary include to supply adequately all the known necessary vitamins?
6 What are the primary functions of vitamin A?
7 What results from an insufficient amount of vitamin A in the diet?
8 What is the difference between vitamin A and vitamin A value?
9 What is the daily recommended allowance of vitamin A?
10 What are the primary sources of vitamin A in the diet?
11 What vitamin is known as the "antirachitic" vitamin?
12 Which minerals are also necessary as factors in the prevention of this deficiency disease?
13 Which foods supply vitamin D? What are supplements to these food sources?
14 What vitamin is essential for normal reproduction in certain animals?
15 What is the chief function of vitamin K?

Suggested Projects

1 Examine your own menus Calculate the vitamin A found in your foods during one day How does your intake of vitamin A compare with the recommended allowance? What percentage of vitamin A in your diet comes from animal sources? What percentage from provitamin A sources?
2 Examine your own menus Calculate the vitamin D found in your foods during one day Which foods were rich sources of vitamin D? Were they natural sources or had the foods been fortified?

CHAPTER 12

THE WATER SOLUBLE VITAMINS

There are many water soluble vitamins known to man today. The greatest number are found in the group called the vitamin B complex. All are believed essential to human nutrition, however, deficiency diseases have been identified with three vitamins. The water soluble vitamins are easily lost through improper cooking and storage. They are obtained from a variety of food sources. In some cases, it is believed that intestinal synthesis supplements the usual sources. The water soluble vitamins are stored within the body to a limited extent only so it is necessary to obtain them daily.

The water soluble vitamins consist primarily of vitamin C and the vitamin B complex. Today, we know that the single, water soluble antineuritic, antiberiberi vitamin B no longer exists but that it is a group of vitamins. The water soluble vitamin B described by McCollum and Davis in 1915 as necessary for health and growth in collaboration with fat soluble vitamin A, has undergone many changes. In 1926 Smith and Hendrick found it to be made up of two fractions, the heat labile (destroyed by heat) fraction called vitamin B_1 (antineuritic), and the heat stable fraction called vitamin B_2 or G, or the P P factor, the latter designation because Goldberger found it contained the pellagra preventing factor. Experimental studies with this second fraction (vitamin B_2) have since shown it to be composed of many substances and not merely a single entity as is vitamin B_1. Therefore we speak of the vitamin B_2 complex and know that it can be divided into vitamins B_2 (riboflavin), nicotinic acid or niacin, B_6 or pyridoxine, pantothenic acid, biotin, para amino benzoic acid, choline folic acid, B_{12} and perhaps others. The water soluble vitamins will be discussed under their separate headings.

As indicated in Chapter 3, many cereal products on the market today are enriched with thiamine, riboflavin, and niacin. This increases immeasurably the intake of these essential water soluble vitamins.

Vitamin C—Ascorbic Acid, $C_6H_8O_6$

For centuries scurvy, the deficiency disease resulting from lack of vitamin C, has been known to be due to a stale diet. Sailors on long sea voyages "fell sick and died" from a typical disease, apparently only because no fresh food was obtainable. In reading the history of scurvy it is all too evident that the knowledge obtained from empirical (experimental rather than scientific) observation was forgotten and rediscovered many times.

In the stories of the Crusades in the middle of the thirteenth century one finds described the spongy condition of the gums which was so severe that "the barber surgeons were forced to cut away the dead flesh from the gums to enable the people to masticate their food." Other descriptions mentioned the prevalent tendency to great weakness and black spots on the legs. Long bones may be rarefied, sometimes fractured at the junction of the shaft and epiphysis; ribs may be swollen and sometimes fractured. In young children there is a typical apprehensive cry from fear of being touched, extreme irritability, and restlessness. Anemia is frequently present.

The first scientific study of scurvy was made in 1757 by James Lind, a surgeon in the English Navy. He took twelve men suffering with scurvy and to each he gave different medication. After 6 days, the pair receiving 2 oranges and 1 lemon daily had improved and one went back to active duty. The other was well enough to be appointed nurse to the other ten who were still suffering. He thereby showed that citrus juice was the only effective cure. As a result of this report, lemons were regularly included in the diet of English sailors and scurvy was practically eliminated. The words "limer" and "limey" arose from this experiment.

Just before the beginning of this century (in 1883), Sir Thomas Barlow described the disease as it occurred in babies, and it became known as Barlow's disease. Babies fed too long on boiled milk and gruels were prone to develop this condition. Today, orange juice included with the formula of a bottle fed baby is a recognized procedure.

The molecular structure of ascorbic acid is closely related to the monosaccharide sugars (glucose, fructose, and galactose). Ascorbic acid, a white crystalline powder, readily oxidized and

rendered inactive in alkaline solution has the formula $C_6H_8O_6$ It was originally known as hexuronic acid Later the term cevitamic acid was given to the crystalline product used for clinical purposes Now however both chemically and clinically it is called ascorbic acid

The most clearly established function of ascorbic acid probably is that of maintenance of intercellular substance In fact, scurvy has been characterized as a condition in which defective inter cellular materials are formed With complete deprivation of vitamin C it has been reported that certain skeletal tissues formed a fluid material rather than their natural products den tine or bone and that the administration of the vitamin causes the liquid to solidify or jell It has also been suggested that with a deficiency a break down reaction occurs which results in the abnormal condition The exact mechanism of this action is still not proved but at least it is definite that a defective mechanism does result and that the normal process is interfered with This abnormality of intercellular material permits leakage of blood from the capillaries in the scorbutic individual when pressure is applied

Inasmuch as vitamin C is necessary for tissue respiration as part of the oxidation reduction system of the body in the ab sence of the vitamin the body cells cease to function normally and probably this contributes to the breakdown of or failure to build normal body structures Failure of tissue to heal in the absence or with a deficiency of ascorbic acid has resulted in its widespread and successful use in surgery

It is also suggested that vitamin C plays a role in combating and neutralizing the toxins of infectious diseases and that it may be concerned in the formation of specific antibodies Its role in the control of glandular secretion is also under considera tion

Complete absence of the vitamin or its presence in only trace amounts in the diet results in frank scurvy

Subclinical deficiencies those instances where the clinical symptoms are not sufficiently definite to suggest the disease im mediately but where the more sensitive tests for deficiency can prove its existence are now recognized When the vitamin C intake is below the requirement level vague ill health may re sult and there are a number of symptoms which appear either

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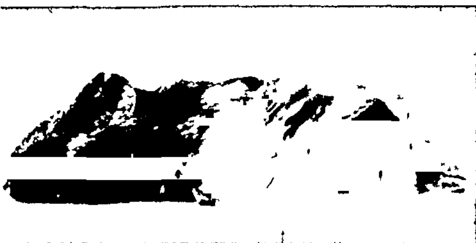


Fig 36—Vitamin C is needed to prevent scurvy The guinea pig is suf ering with scurvy due to lack of vitamin C This deficiency also affects the eeth and gums of human beings (Courtesy Wisconsin Alumni Research oundation)



Fig 37—This guinea pig a litter mate has received a diet adequate in vitamin C

It is generally agreed that the minimum amount of ascorbic acid necessary for the prevention of frank scurvy is from 10 to 20 mg daily However as indicated by the National Research

singly or in combinations. Inadequate intake or subclinical scurvy may be *characterized by loss of appetite, vitality and weight,* irritability and apprehension, muscular weakness, joint pains and swelling, loosening and decay of teeth, spongy gums, hemorrhage—cutaneous, intramuscular, and joint—anemia, rarefaction of long bones, fracture at junction of shaft and epiphyses, gastrointestinal tract disturbances, and predisposition *to infections and lesions.*

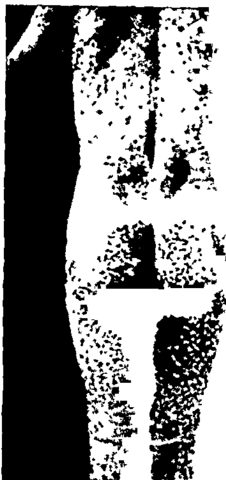


FIG 35.—Due to an increase in the fragility of the capillaries, rupture readily takes place on pressure either constant or abrupt (From Harris The Vitamins, Cambridge University Press.)

An interrelationship among ascorbic acid, folacin, and vitamin B_{12} has been shown experimentally. Also, there seems to be a relationship between vitamin C and the oxidation of two amino acids, phenylalanine and tyrosine. The adrenal glands are known

to have a normally high content of vitamin C According to present knowledge, man, monkey, and the guinea pig are the only species that require ascorbic acid in the diet All others seem to be able to synthesize the amounts needed

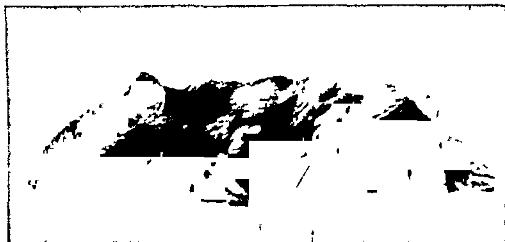


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It is generally agreed that the minimum amount of ascorbic acid necessary for the prevention of frank scurvy is from 10 to 20 mg daily However, as indicated by the National Research

Council, the recommended allowances represent an appraisal of all the evidence available which suggest amounts needed by man The allowances do not represent "saturation" values It is suggested that intakes which include the amounts of vitamin C found in Table 25 may not be satisfactory for the preservation of optimum health through long periods of time or when the body is subjected to common forms of stress However, the recommended allowances are more than three times the minimum amount mentioned above

Ascorbic acid is abundantly supplied by citrus fruits (½ cup of orange juice yields approximately 60 mg of vitamin C) Under current commercial processes both canned and frozen citrus fruit juices may be accepted as equivalent in vitamin C potency to the fresh fruit juice Other fruits, including tomatoes, are good sources All leafy green vegetables and sprouted seeds are excellent sources Potatoes, because of the frequency of their

TABLE 25

RECOMMENDED DAILY DIETARY ALLOWANCES FOR ASCORBIC ACID

Food and Nutrition Board, National Research Council, Revised 1963

	AGE YR	WEIGHT KG	(LB)	HEIGHT CM	(IN)	ASCORBIC ACID MG
Men	25	65	(143)	170	(67)	75
	45	65	(143)	170	(67)	75
	65	65	(143)	170	(67)	75
Women	25	55	(121)	157	(62)	70
	45	55	(121)	157	(62)	70
	65	55	(121)	157	(62)	70
	Pregnant (3rd trimester)					100
	Lactating (850 ml daily)					150
Infants	0 1/12*					
	1/12 3/12	6	(13)	60	(24)	30
	4/12 9/12	9	(20)	70	(28)	30
	10/12 1	10	(22)	75	(30)	30
Children	1 3	12	(27)	87	(34)	35
	4 6	18	(40)	109	(43)	50
	7 9	27	(59)	129	(51)	60
Boys	10 12	35	(78)	144	(57)	75
	13 15	49	(108)	163	(64)	90
	16 20	63	(139)	175	(69)	100
Girls	10 12	36	(79)	144	(57)	75
	13 15	49	(108)	160	(63)	80
	16 20	54	(120)	162	(64)	80

*See Table 3 for explanatory footnote

use in the menu by many may serve as a good source of vitamin C. However throughout the winter ascorbic acid is lost from the potato and in the late winter or early spring negligible amounts of this vitamin remain. The daily inclusion of a citrus fruit plus a salad assures an intake of around 75 mg, which is the recommended allowance for the adult. (See Table 25.)

Storage of food at room temperature results in vitamin loss in nonacid fruits or vegetables. The protective action of the natural acid as occurs in citrus fruits and tomatoes results in excellent retention even in the canned products. The leafy salad vegetables and other fruits are not so protected. Maceration of tissues as in the chopping of salad greens also results in an accelerated loss—a point to keep in mind in holding chopped vegetables unduly long.

The precautions discussed later in the chapter for the handling of water soluble vitamins to prevent destruction or loss apply also to vitamin C. Roughly one half of the vitamin can be dissolved out by the cooking water.

TABLE 26

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 75 MG OF ASCORBIC ACID

FOODS	APPROXIMATE AMOUNTS
Orange juice fresh or frozen	⅔ cup
Grapefruit juice canned unsweetened	¾ cup
Tomato juice canned	2 cups
Tomatoes raw	2 medium (300 gm)
Cabbage—finely shredded	1½ cup (150 gm)
Apples 1 medium—approximately 180 gm each	10 apples
Potatoes baked	1 pound
Strawberries raw capped	⅞ cup (130 gm)
Cantaloupe—medium sized	¼ melon
Peas young cooked	1 lb 2 ounces

Adapted from Composition of Foods Raw, Processed, Prepared. U S Department of Agriculture Handbook No 8

Vitamin B₁—Thiamine $C_{12}H_{16}N_4OS$

The disease beriberi has been recognized for many years. The high incidence of this disease led Takaki, an officer in the Japanese navy, to look for its cause. As only the Japanese navy was affected he deduced that the disease was racial or due to their specific dietary which was largely rice. He added meat, milk and vegetables to the rice diet and great improvement resulted.

Eijkman also studied beriberi in the Java prisons about the same time, and, in addition to his studies on human beings, he observed that birds fed on polished rice developed a disease, the symptoms of which resembled those of beriberi Birds fed on whole rice did not develop the disease It was, therefore, obvious that rice polishings played some role in prevention of the disease

Since vitamin B is water soluble and heat labile, it follows that it can be destroyed or lost to varying degrees during cooking unless care is exercised Its destruction is retarded by acid and hastened by alkali Thiamine is very stable in the dry form

Thiamine is essential for normal growth, appetite, tonicity of the gastrointestinal tract, and proper nerve function Thiamine is also essential for the normal metabolism of carbohydrates Without one of the salts of thiamine (cocarboxylase), the break down or oxidation of carbohydrate is upset, for this reason, the thiamine requirement of the body parallels the carbohydrate intake

Thiamine is frequently referred to as the morale vitamin Deficiency of thiamine induces a quarrelsome, "don't care" attitude, reduces efficiency and physical ability, and produces digestive disturbances, while vague symptoms of ill health accompany a feeling of nervousness In addition, research has indicated that thiamine may be necessary for the metabolism of tryptophane, one of the amino acids

Sufferers from beriberi, the deficiency disease of thiamine complain of numbness in the legs pain in the calf muscles and exhaustion Paralysis ultimately becomes marked, the individual has difficulty in breathing, and a specific type of heart trouble develops This is known as "beriberi heart" It is characterized by an enlarged heart, a decreased circulation time and elevated or normal venous pressure Upon administration of vitamin B_1 recovery is rapid, if no therapy is given the patient dies A characteristic wasting in the ends of certain nerves can be demonstrated at autopsy, a peripheral neuritis or peripheral neuratrophy

It is recognized by most that the occurrence of beriberi in the United States is rare It has been suggested that even mild thiamine deficiency is seldom found However, this is not the case in other parts of the world In 1947 beriberi was responsible for 24,000 lives in the Republic of the Philippines This may be

Fig. 38.—a, Rat maintained on vitamin B [illegible] complex-free diet supplemented with adequate crystalline vitamin B1 and crystalline flavin (i.e., rat is deficient in vitamin B6) and in [illegible] growth [illegible]. b, Two weeks after receiving Cerelexin (a vitamin B complex [illegible]). Attention is called to greatly improved dermatitis and restored growth [illegible]. c, After five weeks Cerelexin has restored the animal to a completely healthy and normal condition. Observe the remarkable growth [illegible]. (Courtesy The Upjohn Company, Kalamazoo, Mich.)

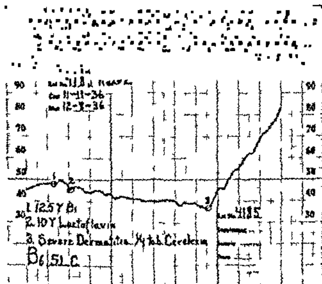


Fig. 39.—Growth chart of rat shown in Fig. 38. (Courtesy The Upjohn Company, Kalamazoo, Mich.)

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Fig 39 —Growth chart of rat shown in *Fig 38* (Courtesy The Upjohn Company Kalamazoo Mich)

expressed in still another way in 1946, out of every 100 000 people approximately 170 died of tuberculosis and approximately 150 from beriberi (the first and second causes of death)

About that time the Bataan experiment,' as it is frequently referred to was instigated One of its objectives was to demonstrate that the incidence of beriberi might be appreciably re



Fig 40—Cantonese slave girl showing the result of vitamin B deficiency the atrophy and degeneration typical of nutritional neuritis In beriberi (outright B deficiency) edema may or may not be present Dry and wet forms exist (From Talbot Clinical Pediatrics D Appleton Century Co Inc)



Fig 41 —Lack of vitamin B These rats are from the same litter The one on the left had enough vitamin B_1 The other received none Notice the result on general health and growth as well as on muscular control (Courtesy Wisconsin Alumni Research Foundation)

duced by the use of enriched or fortified rice. In 1947 a survey of approximately 12% of the population revealed a high incidence of beriberi as determined by clinical examinations. For two years, one segment of the population was supplied with fortified rice. For one pound of rice 2 mg. of B_1, 15 mg. of niacin and 13 mg. of iron were added. The control area received the rice normally used by the people which was unfortified. During the experiment, the incidence of beriberi in the area which received fortified rice was reduced approximately 89%. There was no change in the control population. The enriched rice was acceptable, as it did not differ appreciably in flavor, or texture, from that to which the people of Bataan were accustomed.

The recommended allowances of thiamine are based upon the concept that a ratio exists between calories and thiamine throughout the entire caloric range. However, it is believed that as the caloric expenditure increases above the basal levels, the proportion of thiamine required decreases. Thus, the recommended allowances are based on 0.5 mg. per 1,000 calories for energy needs less than 3,000 calories. It is thought that 0.2 mg. for each additional 1,000 calories above the 3,000 calorie level may be sufficient. If the diet consists of less than 2,000 calories, less than 1 mg. of thiamine is not recommended. It has been estimated that the minimum requirement for adults may be about 0.23 mg. per 1,000 calories. However, it must be pointed out that requirements vary with different persons and with the amount of carbohydrate in the diet.

While rice is a major source of thiamine for many people in the world, since it might supply from 40 to 90% of the calories in their diet, no one food in the American diet may be regarded as a single important supply of thiamine. *Vitamin B_1 from many foods must be combined to meet the daily requirements of thiamine.* Yeast, wheat germ, whole grain *cereals, enriched* breads and cereal products, meats, glandular and muscle meats, nuts, milk, green vegetables, *and fruits are all sources of* thiamine. Concentrates are prepared from yeast, wheat germ, rice polishings, *or* liver.

Unlike the fat soluble vitamin A, thiamine is not stored to any *extent in the animal body.* Stress, such as febrile diseases, or

TABLE 27

RECOMMENDED DAILY DIETARY ALLOWANCES FOR THIAMINE

Food and Nutrition Board, National Research Council, Revised 1953

	AGE YR	WEIGHT KG	(LB)	HEIGHT CM	(IN)	THIAMINE MG
Men	25	65	(143)	170	(67)	1.6
	45	65	(143)	170	(67)	1.5
	65	65	(143)	170	(67)	1.3
Women	25	55	(121)	157	(62)	1.2
	45	55	(121)	157	(62)	1.1
	65	55	(121)	157	(62)	1.0
	Pregnant (3rd trimester)					1.5
	Lactating (850 ml daily)					1.5
Infants	0-1/12*					
	1/12-3/12	6	(13)	60	(24)	0.3
	4/12-9/12	9	(20)	70	(28)	0.4
	10/12-1	10	(22)	75	(30)	0.5
Children	1-3	12	(27)	87	(34)	0.6
	4-6	18	(40)	109	(43)	0.8
	7-9	27	(59)	129	(51)	1.0
Boys	10-12	35	(78)	144	(57)	1.3
	13-15	49	(108)	163	(64)	1.6
	16-20	63	(139)	175	(69)	1.9
Girls	10-12	36	(79)	144	(57)	1.2
	13-15	49	(108)	160	(63)	1.3
	16-20	54	(120)	162	(64)	1.2

*See Table 3 for explanatory footnote

TABLE 28

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 1.2 MG OF THIAMINE

FOOD	APPROXIMATE AMOUNT
Whole wheat bread	17 slices
Enriched white bread (2% nonfat milk solids)	20 slices
Oatmeal, cooked	5½ cups
Beef, round, without bone	60 ounces (3¾ pound)
Pork, loin or chops, without bone	4 ounces
Liver, beef, fried	16 ounces (1 pound)
Milk, whole	13⅓ cups (3¼ quarts)
Egg, medium, raw	24 (2 dozen)
Kale, cooked	15 cups
Split peas, dry	¾ cup

Adapted from Composition of Foods—Raw, Processed, Prepared, U. S. Department of Agriculture Handbook No. 8

surgery may rapidly deplete the small thiamine reserves, hence it is necessary to include thiamine regularly in the diet in order to prevent deficiencies

Vitamin B_2—Riboflavin, $C_{17}H_{20}N_4O_6$

Some of the early history relating to the discovery of vitamin B_2 is discussed at the beginning of this chapter However, it is of interest to note that riboflavin was recognized as early as 1879 as a pigment in whey In 1935 *identification and synthesis* of riboflavin was reported





boflavin deficiency in the diet
iet Below rat that received a
icrograms of riboflavin weekly
or cataract The animals were
per ment at which time they
Day Darby and Langston J
Nutrition 13 39 1937)

A number of flavins (colored substances) occur in nature and all are identical They are found in milk (lactoflavin), egg (ovo flavin) grass, liver kidney, etc The source names have been *dropped in favor of the name riboflavin* This is a yellowish green fluorescent substance, heat stable but labile in alkali or *upon exposure to light Like the rest of the vitamin* B complex riboflavin is water soluble Practical studies in cookery indicate that it is little affected by home stewing *methods of meat* cookery, but there are appreciable losses when meats are roasted or fried About 5 to 20% loss occurs in the canning *process There* is some loss in riboflavin content in milk during the process of

pasteurization and irradiation Of more direct interest, however, is the fact that loss may be as high as 75% after the milk has been bottled and exposed to direct sunlight for three and one-half hours Thus, the homemaker should take proper precautions to insure adequate protection of milk bottles from light

It is also known as vitamin G Riboflavin is of interest because it provides another link between vitamins and enzymes It, too, is *involved in the metabolism and breakdown of carbohydrate*



A *B*

Fig 43 — Cheilosis responds to treatment *A* Child 6 years old with typical lesions of ariboflavinosis involving the upper and lower lips but not extending to the buccal mucosa Other typical manifestations of riboflavin deficiency include photophobia dimness of vision and superficial keratitis At right is the patient after a period of vitamin therapy The lesions in this case were obviously the result of ariboflavinosis Investigation indicated that the family of which the child was a member subsisted principally on starchy foods namely macaroni and potato with fruits and vegetables being eaten only occasionally Meat was served once weekly and a quart of milk was apportioned daily among six *B* After treatment with riboflavin (Reproduced from Therapeutic Notes Parke Davis & Co through the courtesy of Dr William P Shields and the New England Journal of Medicine)

A clear cut human deficiency disease (ariboflavinosis) is not described, but a number of symptoms arise from lack of riboflavin Lack of riboflavin may be associated with cataract In

conjunction with vitamin A, riboflavin probably is needed for the regeneration of the visual purple (rhodopsin) of the retina of the eye. Conjunctivitis, lacrimation, burning of the eyes, photophobia, and dimness of vision also occur.

A characteristic dermatitis about the nose and mouth of human beings also results from lack of this vitamin The occurrence of comedones, giving a "shark skin" appearance to the region of the nose and eyes, is suggestive of riboflavin deficiency. Lesions appear at the angles of the mouth (cheilosis), fine scaly desquamation in the nasolabial folds, in the vestibule of the nose, around the eyes, and on the ears. The lips are reddened and denuded, and a glossitis appears.

It has been shown that clinical manifestations of a riboflavin deficiency may occur in man when the intake is less than 0 6 mg daily Lack of overt deficiency signs, such as characteristic lesions, does not necessarily mean an adequate intake of ribo-

TABLE 29

RECOMMENDED DAILY DIETARY ALLOWANCES FOR RIBOFLAVIN
Food and Nutrition Board, National Research Council, Revised 1953

	AGE YR	WEIGHT KG	(LB)	HEIGHT CM.	(IN.)	RIBOFLAVIN MG
Men	25	65	(143)	170	(67)	1 6
	45	65	(143)	170	(67)	1 6
	65	65	(143)	170	(67)	1 6
Women	25	55	(121)	157	(62)	1 4
	45	55	(121)	157	(62)	1 4
	65	55	(121)	157	(62)	1 4
	Pregnant (3rd trimester)					2 0
	Lactating (850 ml daily)					2 5
Infants	0 1/12*					
	1/12 3/12	6	(13)	60	(24)	0 4
	4/12 9/12	9	(20)	70	(28)	0 7
	10/12 1	10	(22)	75	(30)	0 9
Children	1 3	12	(27)	87	(34)	1 0
	4 6	18	(40)	109	(43)	1 2
	7 9	27	(59)	129	(51)	1 5
Boys	10 12	35	(78)	144	(57)	1 8
	13 15	49	(108)	163	(64)	2 1
	16 20	63	(139)	175	(69)	2 5
Girls	10 12	36	(79)	144	(57)	1 8
	13 15	49	(108)	160	(63)	2 0
	16 20	54	(120)	162	(64)	1 9

*See Table 3 for explanatory footnote

TABLE 30

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 1.4 MG. OF RIBOFLAVIN

FOOD	APPROXIMATE AMOUNT
Liver, beef, fried	$1\frac{1}{4}$ ounces
Milk, whole	$3\frac{1}{2}$ cups
Kale, cooked	$5\frac{3}{4}$ cups
Beef, round, without bone	22 ounces
Pork loin, without bone	21 ounces
Egg, medium, raw	10 (each)
Bread, enriched white, 3–4% nonfat milk solids	36 slices
Bread, whole wheat	46 slices
Split peas, dry	$2\frac{1}{4}$ cups

Adapted from Composition of Foods, Raw, Processed, Prepared, U. S. Department of Agriculture Handbook No. 8.

flavin. The appearance of deficiency signs has been said to vary with the individual and with the degree of environmental stress. Thus on the basis of existing research it is believed that a minimum of 1.1 mg. per day is needed to maintain tissue reserves. The daily recommended allowances for riboflavin may be found in Table 29.

Riboflavin is found in many foods. In addition, some evidence has been advanced showing that this vitamin may be synthesized in the intestinal tract. Some riboflavin from this source may be available to the body. However, it is customary to consider foods as the source of B_2. Liver, kidney, milk, yeast, wheat germ, muscle meat, egg, and leafy green vegetables are the main sources of riboflavin. Other sources contribute little.

Niacin (Nicotinic Acid), $C_6H_5O_2N$

The background of our present knowledge of the vitamins always makes fascinating reading, and this is particularly true of nicotinic acid and its specific deficiency disease pellagra. Two hundred years ago this disease was described and attributed to faulty diet. At one time it was thought to be due to a poison developing in corn (maize); another theory was that corn contains a photosensitizing substance similar to that found in buckwheat which, when acted upon by sunlight, produced characteristic skin changes in pellagra. Neither theory has any proof except the coincidence of the pellagra prevalence in some corn-eating sections. The word pellagra means rough or inflamed skin. Spies suggests that pellagra should not be considered a disease of the skin but a systemic disturbance.

To Goldberger (1913) is due the credit for establishing the pellagra as a deficiency disease which could be cured by the administration of brewer's yeast Later he found that an acid extract of yeast contained the P P (pellagra preventing) factor as did also certain other foods Elvehjem (1937) later showed, by his experiments on dogs, that the nicotinic acid obtained from liver concentrates was curative for blacktongue in dogs (a syndrome similar to pellagra in man) and from that Spies and his workers, and Smith and his associates, using nicotinic acid, obtained dramatic cures of pellagra Recently, Spies and his coworkers have suggested that both vitamins B_2 and B_6 aid in making the cures permanent

Nicotinic acid is a white, crystalline, water soluble, heat stable alkali labile powder, having the formula $C_6H_5O_2N$ Nicotinic acid was prepared in pure chemical form as early as 1867, but was not recognized as the pellagra preventing vitamin until 1937 1938 It is produced by oxidizing nicotine, during which process the toxic effect of the nicotine is destroyed and the vitamin is formed It is the most stable member of the B complex

One of the most important functions of niacin, apart from its pellagra preventing action, is its participation as components of coenzyme I and coenzyme II These are concerned with glycolysis and respiration Thus as indicated by Sherman, niacin along with thiamine and riboflavin is thought to be concerned with the intermediary and oxidation reduction metabolism

The symptoms resulting from its lack (pellagra) are trembling of the head, burning pains in the mouth, vesicles on the lips coated tongue, weakness, loss of appetite, gastrointestinal upsets, and typical skin lesions on the backs of the hands, the dorsal aspects of the feet, and around the neck and ankles

Mild mental disturbances frequently are first to appear—confusion, dizziness, poor memory, and depression Later the symptoms become more violent and hallucinations and delusions of persecution appear The symptoms have been described as the 4 D's dementia diarrhea, dermatitis, and death

Recent studies indicate that the entire picture is not yet clear There seems to be a definite relationship between the incidence of pellagra and the amount of corn found in the diet Not only is this due to the fact that when the greater part of the diet is

TABLE 31

RECOMMENDED DAILY DIETARY ALLOWANCES FOR NIACIN
Food and Nutrition Board, National Research Council, Revised 1953

	AGE YR.	WEIGHT KG	(LB)	HEIGHT CM	(IN)	NIACIN MG
Men	25	65	(143)	170	(67)	16
	45	65	(143)	170	(67)	15
	65	65	(143)	170	(67)	13
Women	25	55	(121)	157	(62)	12
	45	55	(121)	157	(62)	11
	65	55	(121)	157	(62)	10
	Pregnant (3rd trimester)					15
	Lactating (850 ml daily)					15
Infants	0 1/12*					
	1/12 3/12	6	(13)	60	(24)	3
	4/12 9/12	9	(20)	70	(28)	4
	10/12 1	10	(22)	75	(30)	5
Children	1 3	12	(27)	87	(34)	6
	4 6	18	(40)	109	(43)	8
	7 9	27	(59)	129	(51)	10
Boys	10 12	35	(78)	144	(57)	13
	13 15	49	(108)	163	(64)	16
	16 20	63	(139)	175	(69)	19
Girls	10 12	36	(79)	144	(57)	12
	13 15	49	(108)	160	(63)	13
	16 20	54	(120)	162	(64)	12

*See Table 3 for explanatory footnote

TABLE 32

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 12 MG OF NIACIN

FOODS	APPROXIMATE AMOUNTS
Liver, beef, fried	3 ounces
Bran (breakfast cereal, almost wholly bran)	1 cup
Beef, round, without bone	7½ ounces
Pork, loin, without bone	18 ounces
Bread, enriched white, 2% nonfat milk solids	60 slices
Bread, whole wheat	17 slices
Milk, whole	40 cups
Potato, baked	2 pounds
Split peas, dry	2 cups
Peanuts, salted, roasted	½ cup

Adapted from Composition of Foods Raw Processed Prepared U S Department of Agriculture Handbook No 8

It has been suggested that pyridoxine or an associated form is concerned with the utilization of the unsaturated fatty acids—and the amino acid tyrosine

TABLE 33

PYRIDOXINE CONTENT OF FOODS*

	MG PER 100 GM
Yeast, brewer's	2 47
Yeast, Fleischmann's	3.95
Yeast extract	1 03
Wheat germ	1 03
Skim milk powder	0 38
Whole milk	1 25
Quaker rolled oats	0 25
Split peas	0 40
Leg of lamb	0 45
Beef liver	0 81
Liver powder (Wilson)	1 45
Vitab (rice bran concentrate)	5 17

*These figures are taken from unpublished assays provided by Dr C A Elvehjem and reproduced from Nutritional and Vitamin Therapy in General Practice by Edgar S Gordon with permission of The Year Book Publishers

According to Spies, the deficiency symptoms are extreme nervousness irritability, abdominal pain, weakness, and difficulty in walking Pyridoxine presumably is essential for hemoglobin formation although just how is not known

Although the need for vitamin B_6 is generally accepted, it is difficult to establish a minimum requirement Intestinal synthesis is believed to contribute a considerable proportion of the total amount needed However, it has been suggested that the requirement may be similar to that for thiamine, namely, about *1 5 to 2 mg daily* With adequate intake of the potent whole grain cereals legumes, seeds, and seed oils (corn cottonseed), liver kidney and cane molasses, body requirements are undoubtedly met Fish liver oils are good sources, meats fair, and fruits and vegetables poor sources

Pantothenic Acid, $C_9H_{17}NO_5$

Pantothenic acid, formerly known as "filtrate factor," was originally discovered as a "yeast growth factor" Now it is known also to be essential for animal well being Among the effects attributed to deficiency of pantothenic acid in animals are emaciation loss of and graying of hair ulcers in the intestinal tract, adrenal kidney and cardiac damage, tissue dehydration,

and nerve degeneration, which results in a "goose step" gait. In fact, every tissue in the body seems to be affected by pantothenic acid deficiency. The word itself means "everywhere."

Human deficiencies are not yet clearly pictured. It is probable, however, that pantothenic acid is essential for human nutrition and that in some way its action is associated with riboflavin. The possibility of a relationship between human adrenal insufficiency and pantothenic acid deficiency is worth further study, as is its role in maintaining the integrity of nervous tissue. In

TABLE 31

DISTRIBUTION OF PANTOTHENIC ACID IN FRESH FOODS IN MICROGRAMS PER GRAM

Liver	40
Egg yolk	63
Eggs	27
Broccoli	14
Peanut meal	53
Buttermilk, churned	4.6
Sweet potatoes	11
Lean beef	10
Beef liver	66
Pork liver	55
Beef heart	22
Pork loin	19
Leg of lamb	13
Skim milk	3.6
Squash	3
Canned salmon	7
Irish potatoes	6.5
Wheat bran	24
Canned pumpkin	4
Whole milk	2.8
Rice bran	22
Split peas	21
Tomatoes	1
Soybean meal	14
Carrots	2
Rolled oats	11
Wheat	11
Barley	10
Spinach	1.2
Onion	1.2
Yellow corn	8
English walnuts	8
Oranges	0.7
Polished rice	4
Banana	0.7
Prunes	0.6
Raisins	0.6
Almonds	0.3

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animal experimentation, pantothenic acid has been shown to be involved in many reactions, as well as in interrelationships with other nutrients

Pantothenic acid is fairly stable to moist heat especially at a neutral pH, but it is destroyed by prolonged dry heat Studies as to loss during cooking are meager, however, the loss is probably of similar magnitude to that of thiamine since its solubility and stability are similar

Pantothenic acid is widely distributed in foods Liver is one of the richest natural sources Meat, cereals, yeast, egg yolk peanuts, and milk are good sources In the process of milling grains into flour, only about one half of the pantothenic acid is lost, contrary to the losses of other members of the B group

The requirement levels are not yet known, but one sees speculative suggestions that the daily requirement for the normal adult is from 5 to 10 mg Elvehjem, however, computes that the probable requirement may be around 5 mg a day or the amount in 100 gm of liver It has been estimated that the amount of pantothenic acid found in a well balanced diet of 2,500 calories is approximately 10 mg

Choline, $C_5H_{15}O_2N$

Choline has been known for many years to be a component part of the phospholipid lecithin, but not until about 1932 was its importance in nutrition demonstrated At that time, it was shown by Best to be related to the mobilization of fatty acids in the body With choline deficiency, liver fat rapidly accumulates It is reported to be indispensable for lactation in adult rats and to prevent paralysis in suckling rats The usual depression of growth rate occurs with its absence It prevents hemorrhagic kidney degeneration in young rats and perosis (slipped tendon) in chicks and turkeys Recent studies seem to indicate that choline takes part in the process known as transmethylation, the transfer of methyl groups from one compound to another Thus it may be an integral part in protein metabolism

A choline requirement has not been established However, it has been estimated that the choline content of the average diet may be from 250 to 600 mg daily Inasmuch as lecithin contains choline, meats cereals, vegetables, and eggs become good sources of choline

Para aminobenzoic Acid, $C_7H_7NO_2$

Para aminobenzoic acid, also designated sometimes as PAB and PABA, a simple derivative of benzoic acid, has been known to the chemists for years but not until 1941 was it shown to have vitamin-like activity. It was first recognized through its effect on bacterial growth. Positive and negative experimental evidence has been presented indicating that graying of the fur of



Fig 45.—The rat on the left whose hair was originally black shows graying of the hair as the result of a diet deficient in the anti-gray hair factor. Its litter mate on the right received a normal diet. (Reproduced from Therapeutic Notes courtesy of Parke, Davis & Co.)

rats can be produced and cured by the para aminobenzoic acid level of the diet. It has been reported to be involved in normal pregnancy and lactation in addition to the other B vitamins. The antagonistic action between para aminobenzoic acid and the bactericidal effects of sulfanilamide (and the related drugs) is of current interest. The finding that para aminobenzoic was capable of reversing or preventing the bactericidal action of the

sulfonamides was the beginning of the antivitamin theory. It appears to be a competitive struggle between two structurally similar compounds for the same role. Clear-cut experimental data are lacking as to the role of para-aminobenzoic acid in human nutrition, that is, the requirement and distribution

Biotin, $C_{10}H_{16}O_3N_2S$

Biotin has been recognized for some time as a dietary essential for microorganisms, but its importance to the animal body has only recently been appreciated. Its formula was determined



Fig 46.—Biotin deficiency (egg white injury) This animal, aged 85 days has received a diet containing 35% uncooked egg white since the age of 21 days and exhibits typical, acute exfoliative, desquamative (seborrheic) dermatitis, accompanied by loss of hair The dermatitis is particularly severe about the head, flanks and forefeet (Courtesy Research Laboratories of the S M A Corporation Chagrin Falls, Ohio)

by du Vigneaud in 1942 It has also been known for many years that characteristic symptoms developed in rats fed on diets containing large amounts of raw egg white These symptoms include dermatitis, especially involving the feet, spectacled eyes and a progressive alopecia, poor feathering (in chicks), slow growth, and a curious paralytic condition Experimental studies revealed the fact that an albumin—avidin—active in raw egg

white combines with the biotin of the egg white in such a manner as to render it inactive A deficiency is thereby produced The factor thus inactivated was formerly called vitamin H Biotin and vitamin H are now known to be identical Recent investigations have indicated that biotin functions in intermediary metabolism as part of the coenzyme system which acts in carbon dioxide fixation processes

Human studies, of course, will be forthcoming as biotin has now become commercially available One study was reported in which experimentally induced human biotin deficiency resulted in dry, peeling skin with a pronounced grayish pallor muscle pains lack of appetite nausea, distress around the heart, and after the fifth week the mild depression progressed to extreme lassitude, somnolence and in two subjects out of the four, a mild state of panic All symptoms cleared within four days after biotin medication was begun Biotin may be supplied to the animal in part through intestinal synthesis In addition, liver, kidney, yeast and egg yolk are the chief food sources

Inositol, $C_6H_{12}O_6$

Inositol was first isolated from meat in 1850 but its role as a possible vitamin was not recognized until 1940 The suggestion that it is a member of the B group is strengthened by the fact that it as the other members of the group is universally present in living matter although its distribution is more erratic and it appears in greater abundance Inositol is a crystalline substance with a sweet taste The phytin phosphorus of cereals has been found to be inositol hexaphosphoric acid

A definite relationship appears to exist between inositol and pantothenic acid Even when an adequate amount of inositol is present in the diet it is not absorbed in the absence of pantothenic acid Inositol has been shown to cure mouse alopecia and spectacled eyes and to affect growth The curative action and growth effect in some way appear related to the type and amount of fat in the diet Reports indicate it to be required by the lactating rat When injected into dogs, it accelerates intestinal motility Its significance in human nutrition is not known However, it is believed to be a factor in stimulating gastrointestinal motility and to be involved in fat metabolism

Spleen, heart, kidney, brain, thyroid, and testes are found to have an especially high content of inositol. Large amounts are found distributed in the plant kingdom in the form of phytin (the calcium magnesium salt of inositol hexaphosphoric acid). No suggestion of requirement has been made.

Folacin

Folacin refers to one of the newer members of the B complex. It is also called folic acid by which it was universally known until the name folacin was adopted by the American Institute of Nutrition in 1949. It is also referred to as the "pteryolglutamates." It is believed that there are at least three chemically related compounds which may be grouped together under the name of folacin.

Its synthesis in 1945 clarified reports on various postulated members of the B complex. There had been reports for a period of ten years on vitamins which were concerned with blood formation and growth in various animals. Vitamin M was essential for monkeys, factor U necessary for chicks, another deficiency condition in chicks was labeled as due to a deficiency of B_c. In bacteriological studies, need of a growth factor was found—a factor given the name of *Lactobacillus casei* factor, one *Streptococcus lactis R*—and another potent factor which was called folic acid due to its abundance in leafy green plants. This factor was later found to occur in liver, kidney, yeast, and mushrooms. These independent studies were drawn together by the final isolation and synthesis of folic acid. This folic acid seemed to be the effective agent in each of the studies. So folic acid was accepted as the common vitamin.

Due to its relationship to experimental macrocytic anemia folacin was immediately hailed as the curative factor. Research has found it to be effective therapeutically in the macrocytic anemias of pregnancy, infancy, in nutritional macrocytic anemia and in sprue. However, when used as a treatment in pernicious anemia it was found neither to prevent nor to alleviate the neurological symptoms. Investigators have found that folacin may be related to the metabolism of tyrosine, an amino acid. In some laboratory animals folacin seems to be important in the reproductive processes.

Although folacin has been effective in the clinical treatment of several macrocytic anemias, it does not follow that a deficiency disease exists. To date, a human requirement for the vitamin has not been established. It is recognized that it is essential to human nutrition. The National Research Council suggests* that it seems probable that dietary intakes of the order of less than 1 mg per day can be expected to cover any nutritional needs for folic acid activity.

Folacin is present in all animal tissues and is released by autolysis, a fact which suggests that it has functional activity. The exact distribution in foodstuffs is incomplete, but it is known that fresh green leafy vegetables and organ meats are rich sources. Additional good sources are lean beef, veal, wheat cereals, and root vegetables. It is present in other foods, but in smaller amounts.

Vitamin B_{12}

Vitamin B_{12} is the youngest officially recognized member of the B group. It was isolated by painstaking fractionation of liver in an effort to find which fraction of liver was responsible for its antipernicious anemic action. Formerly, the amount of liver needed to control a patient with pernicious anemia was roughly 400 gm daily—nearly one pound.

In 1948 Rickes, Brink, Koniuszy, Wood, and Folkers in the United States and Smith and Parker in England were effective in the isolation of vitamin B_{12}. It is a red substance which contains cobalt and phosphorus. There is still much to be discovered about the chemistry of this vitamin.

Once vitamin B_{12} was found to be effective in the treatment of pernicious anemia, interest was directed toward identifying its place in the intrinsic-extrinsic factor scheme as postulated by Castle (see Chapter 40). The belief is accepted by many that vitamin B_{12} is part, if not all, of the *extrinsic factor*. The function of the intrinsic factor seems to be to insure the absorption of vitamin B_{12}. This does not preclude the possibility of there being other currently unknown functions of the intrinsic factor. Recent research has indicated that pernicious anemia patients lack the intrinsic factor and therefore fail to absorb vitamin B_{12}. It is interesting to note that extremely small dosages of

*Bulletin No. 302, p. 26.

vitamin B_{12}, approximately 1 microgram daily, parenterally, will allow *replacement of the insufficiency in the patient with* pernicious anemia

Investigations have been made to determine if vitamin B_1 is involved in other reactions Some studies have reported that the vitamin may stimulate growth in children Others have failed to demonstrate similar effects Some evidence suggests that vitamin B_{12} may be associated with the metabolism *of* methionine, one of the essential amino acids

The data concerning the distribution of vitamin B_{12} in foods are incomplete The richest food sources so far seem to be liver kidneys, eggs, milk, and muscle meats Future research will contribute to the existing knowledge of the functions, requirement, and sources of vitamin B_{12}, however, in a few short years its importance in human nutrition has been established

The Citrovorum Factor

Folacin and vitamin B_{12} cannot be discussed without some *mention being made of the citrovorum factor This factor is* closely related both chemically and functionally to folacin It *is believed that the citrovorum factor is formed from folacin* within the body There is considerable evidence that this reaction takes place and *that the citrovorum factor is as effective* clinically and for the same conditions as folacin However so far, the *citrovorum factor has not* been as effective with pernicious anemia patients as vitamin B_{12}

Vitamin P

In 1936 Szent Gyorgyi and his co workers postulated the existence of a new vitamin in lemon peel which they called vitamin P, *designating capillary permeability* Szent Gyorgyi believed vitamin P to be citrin a mixture of the flavone glucosides *hesperidin and eriodictyol* The reports of usage of this product have been contradictory However in *1942*, hesperidin chalcone *($C_{22}H_{26}O_{12}$)* was isolated from lemon peel This substance is believed to be the pure form of Szent Gyorgyi s vitamin P Preliminary experiments with this material have shown that it does exert beneficial effect upon the state of the capillaries decreasing the fragility and preventing localized hemorrhages

Lemon is a rich source of this vitamin. A single lemon—juiced, the peel minced, covered with water, and boiled for 10 minutes in a glass container, and the strained liquid added to the lemon juice—has a yield of approximately 150 mg. of vitamin P.

Rutin

More recently, another flavone derivative glucoside has been found in tobacco leaves and buckwheat. It is reported to have physiological activity similar to vitamin P. It is available for clinical use and is under such investigation. The potential value of both of these vitamins is apparent if the final evidence is conclusive in the protection of the vascular system in conditions of high blood pressure.

Miscellaneous Postulated Vitamins

There are other vitamins for which there is as yet no definite proof and which to date have no relation to human nutrition. It can be assumed that if the diet is well balanced and the known vitamins are supplied, the possible obscure vitamins will likewise be present. It is because of the interrelation between the various known vitamins and the additional vitamins found from time to time in food products that it is important to obtain our vitamins from natural sources rather than in commercial form (synthetic vitamins). An exception to this rule will of course be necessary when vitamin intake must be larger than can be supplied by dietary adjustment without raising the intake of certain foods to a level which will result in a compensatory decrease in other essential foods. Such a condition may arise and may conceivably produce other deficiencies.

Among these additional vitamins are:

Grass juice factor—found in summer milk and in green grass which promoted growth of rats and guinea pigs.

Vitamins L_1 and L—lactation factors.

Factor W—a growth factor for rats, chicks, and dogs.

Factors R and S—also growth factors for chicks.

The anti-gray hair factor (antiachromotrichia factor)—both para-aminobenzoic and pantothenic acids have been suggested.

Factor J—factor protective against pneumonia.

A new dietary factor for guinea pigs—found in cream.

The Effect of Cooking Upon Water Soluble Vitamins

Since vegetables are considered one of the major sources of vitamins and minerals in the diet, considerable interest has been shown concerning the *effect of cooking upon the nutritive content of foods* One of the most comprehensive studies is that reported by Krehl and Winters *

In this experiment, twelve vegetables were selected asparagus beets, broccoli, cabbage, carrots, cauliflower, sweet corn (yellow), green beans, peas potatoes, summer squash, and spinach A uniform portion of each vegetable (family sized quantities) was *cooked to a prescribed degree of doneness by* the following methods (1) pressure cooked with ½ cup water added, (2) with sufficient water added just to cover the vegetable, (3) with ½ cup more water than that described in (2) and (4) with no added water, or the "waterless" method After cooking the vegetables were analyzed for the content of the following vitamins and minerals calcium, iron, phosphorus thiamine *riboflavin, niacin, ascorbic acid and carotene*

The specific results are, of course, too detailed to reproduce here However, the investigators made some general conclusions and observations The greatest loss of both vitamins and minerals occurred as a result of cooking by the "old fashioned" method of water to cover (method 3) The smallest loss was found in those vegetables prepared by the "new" or waterless method (method 4) *Vegetables cooked by the other two methods* were similar in results and were intermediate between 3 and 4 in vitamin and mineral retention It must be pointed out that there were variations among individual vegetables Losses of ascorbic acid were the greatest in all methods of cooking

The investigators concluded that of the two factors which affect vitamin and mineral losses in cooking, the leaching effect of cooking water and the influence of oxidation, the leaching out of the vitamins and minerals constituted the most serious source of loss in this study A review of the original report is suggested for an accurate understanding of the effect of the variations in the cooking methods

In general it was found that the retention of minerals was better than that of vitamins

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*Krehl W A and Winters, R W Effect of Cooking Methods on Retention of Vitamins and Minerals in Vegetables J Am Diet A 26 966 9 , 1950

TABLE 35

THE LEADING WATER-SOLUBLE VITAMINS—THEIR FUNCTIONS AND IMPORTANT SOURCES

VITAMINS	FUNCTION	DEFICIENCY SYMPTOMS	PRIMARY SOURCES
Ascorbic acid (vitamin C)	Essential for growth Essential for formation of intercellular cement Aids in prevention of capillary fragility Aids in wound healing	Scurvy (defi ciency disease) Tendency to bruise easily Sore gums Hemorrhages around bones	Citrus fruits Green leafy vege tables Strawberries Cantaloupe Tomatoes Apples Potatoes
Thiamine (vitamin B_1)	Essential for growth Essential for carbohy drate metabolism Essential for normal functioning of nerves Aids normal digestion	Beriberi (defi ciency disease) Retarded growth Nerve disorders Loss of appetite	Pork Whole grain breads and cereals Enriched breads and cereals Beans dry kidney or Lima Peas split Soybeans Liver
Riboflavin (vitamin B_2)	Essential for growth Essential for carbohy drate metabolism Essential for health of skin Essential for normal functioning of eyes	Retarded growth Lesions at cor ners of mouth (cheilosis) Cataract like symptoms and dimness of vision Inflammation of the tongue	Milk Liver Green leafy vege tables Meats—fowl Whole grain breads and cereals Enriched breads and cereals
Niacin	Essential for growth Essential for carbohy drate metabolism Essential for normal functioning of diges tive tract Essential for health of skin Essential for normal functioning of nervous system	Retarded growth Pellagra (defi ciency disease) Glossitis (smooth tongue) Digestive dis orders Mental disturb ances Skin disorders	Liver Lean meats Legumes peas and beans Whole grain breads and cereals Enriched breads and cereals Peanuts

Other investigations have suggested that the method of cook ing is important in the retention of vitamin and mineral value in food Those professionally interested in nutrition continu ally emphasize the dangers inherent in using improper cooking methods

Review Questions

1 What is the chemical name for vitamin C?
2 What is the deficiency disease of vitamin C?
3 What subclinical symptoms may result from an inadequate supply of this vitamin?
4 What are the most important sources of vitamin C?
5 What is the chemical name of vitamin B_1?
6 What is the deficiency disease of this vitamin?
7 What foods are good sources of vitamin B_1?
8 What is the chemical name of vitamin B_2?
9 What are good sources of this vitamin?
10 With which specific disease is niacin associated?
11 Which vitamin is associated with the treatment of pernicious anemia?
12 Name additional fractions of the B complex How are they related to human nutrition? What is known of their reaction in experimental animals?

Suggested Projects

1 Examine your own menus Calculate the thiamine, riboflavin, and niacin found in your foods for one day How does your intake of these vitamins compare with the recommended allowance? If any of these vitamins are below the recommended allowance, how may you increase your diet so as to obtain adequate amounts? Are your suggestions practicable within your pattern of living?
2 Calculate a 1,200 calorie diet for a weight loss regimen Calculate the thiamine, riboflavin, and niacin found in the menus planned Do they meet the recommended allowances for the 25 year old woman? If not, how can you adjust the diet, still keeping within the 1 200 calories, and meet other nutritive needs?
3 Examine your own menus and the calculations obtained in review project No 1 What percentage of your thiamine, riboflavin, and niacin was supplied by enriched products? Would your intake meet recommended allowances without enrichment?
4 Assume you were allergic to milk and milk products Would your menus meet the recommended allowances for thiamine, riboflavin and niacin if this food were omitted in all forms? If not, how could you adjust the menus to obtain adequate amounts of these nutrients?
5 Plan a menu for a 16 year old girl Can you easily obtain the recommended allowances of thiamine, riboflavin, and niacin within the food pattern followed by most teen agers? If not, how might you suggest to her that she modify her menus? Do you think that she would accept your ideas?

CHAPTER 13

MINERALS AND MINERAL METABOLISM

Many minerals and trace elements are believed necessary in normal human nutrition. Deficiencies of a few have been observed; however, it is not known if inadequate dietary intake is always the sole factor in producing a deficiency. Complex interrelationships among minerals, vitamins and organic substances have been noted. There is wide variation regarding the requirement and utilization of minerals. In most cases the need will vary with the age and sex of the individual. While some significant information is available concerning metabolism of minerals, much remains to be discovered.

Minerals, the inorganic constituents of the diet, function in at least three ways. They are constituents of teeth and bone and as such give rigidity and relative permanence to the structures. They are constituents of all soft tissue. Held in solution in the body fluids they influence the irritability of muscle and nerve and maintain the neutrality, osmotic pressure and solvent power of these liquids. They yield no energy and frequently are excreted unchanged. The minerals are occasionally ingested in free form as sodium chloride (NaCl—table salt), but in general they are combined with organic substances.

While all the minerals are equally important, just as every element which is part of the structure of the cell is essential to life, specific attention need be given only to the inclusion of certain minerals in the diet; the others may be assumed to be supplied adequately in the average daily food.

The only minerals requiring special calculation in the diet are calcium (Ca), phosphorus (P) and iron (Fe), except when due to disease condition other mineral constituents of the diet may need adjustment (see section on Modifications of the Normal Diet).

Calcium, sometimes spoken of as an alkaline earth metal, has many important functions within the body. It is present in larger amounts than any other mineral. Approximately 99% of the calcium is involved in the construction and function of the

bones and teeth It is also necessary for the normal clotting of blood (see Chapter 11, Vitamin K), and for the normal contractibility of muscles The alternate contractions and relaxations of the heart muscle are dependent upon the *presence of calcium* sodium, and potassium in the fluid which bathes the heart The blood calcium level is controlled by the parathyroid gland, which is a *tiny gland* in the throat, associated with the thyroid Removal of the parathyroid gland from animals, or a decrease in calcium of the blood from any other cause, results in an increased muscular irritability or tetany (muscle spasm or convulsion) An increase in calcium level results in the reverse effect, extreme lethargy *An increase in potassium (K) has an effect similar to a decrease in calcium, and a decrease in potassium has an effect similar to an increase in calcium* The action is antagonistic Calcium is also concerned with nerve conduction and has been reported to have iron sparing qualities (see paragraph *on Iron page 208*)

On the basis of the information obtained from a number of dietary surveys, it is thought that calcium is the mineral most likely to be deficient in the human dietary Because of the difficulty in diagnosing calcium deficiency clinically, there are no *data to substantiate the evidence disclosed by surveys*

One of the most important considerations in a study of calcium in human nutrition is the amount of calcium that is absorbed from the diet and is therefore available to the individual It is generally accepted that the ability to utilize the calcium in ingested foods will vary to a great extent among individuals In human beings, usually no more than 20 to 30% is absorbed from the diet It has been shown to be greater in children who were actually suffering from deficiency

There are several factors which have been demonstrated to bring about optimum absorption of calcium from foods Among those are (1) the pH of the gastrointestinal tract, calcium is favorably absorbed in the upper part of the small intestine while *the pH is still acid*, (2) the ratio of calcium and phosphorus in the diet an optimum ratio for growth is 1 1 and 2 1 (approximately the ratio found in both human and cow's milk), lower ratios may be sufficient for optimum *utilization in the adult* (3) a high protein diet favors calcium absorption, (4) an adequate supply of vitamin D aids calcium utilization, (5) some

materials form insoluble calcium salts in the gastrointestinal tract and thereby render the calcium unavailable Some of these materials are oxalates phosphorus and phytic acid (6) when there is impaired fat absorption and insoluble calcium soaps are formed calcium absorption is reduced These are some of the factors which influence calcium absorption Because of individual variation some will be important in calcium metabolism in one individual and unimportant in others The recommended allowances (see Table 36) take these factors into account and include a margin of safety ’

TABLE 36

RECOMMENDED DAILY DIETARY ALLOWANCES FOR CALCIUM

Food and Nutrition Board National Research Council Revised 1953

	AGE YR.	WEIGHT KG	(LB)	HEIGHT CM	(IN)	CALCIUM GM
Men	25	65	(143)	1 0	(67)	0 8
	45	65	(143)	170	(67)	0 8
	65	65	(143)	1 0	(6)	0 8
Women	25	55	(121)	15	(62)	0 8
	45	55	(121	157	62)	0 8
	65	55	121)	157	(62)	0 8
	Pregnant (3rd trimester)					1 5
	Lactating (850 ml daily)					2 0
Infants	0 1/12*					
	1/12 3/12	6	(13)	60	(24)	0 6
	4/12 9/12	9	(20)	0	(8)	0 8
	10/12 1	10	22)	5	(30)	1 0
Children	1 3	12	(27)	8	(34)	1 0
	4 6	18	40)	109	(43)	1 0
	7 9	2	(59)	129	(51)	1 0
Boys	10 1	35	8)	144	57	1 2
	13 15	49	(108)	163	64	1 4
	16 20	63	135)	175	(69)	1 4
Girls	10 12	36	(9)	144	57	1 2
	13 15	49	(108)	160	63	1 3
	16 20	54	(120)	16	(64	1 3

*See Table 3 for explanatory footnote

Milk is the richest source of calcium Without the inclusion of at least one pint of milk daily there is usually inadequate intake of calcium Fruits and vegetables especially leafy vegetables are relatively rich in calcium Sherman states that experimental evidence would indicate that the calcium of cabbage

collards, kale, leeks, lettuce, rutabaga, leaves, and turnip tops is well utilized The calcium of spinach, beet greens, and New Zealand spinach, however, is utilized very poorly, if at all The difference is due to the oxalic content of the latter group which interferes with calcium utilization Feeding experiments indicate that orange juice exerts a favorable effect on calcium retention out of proportion to the calcium which it contains Meats and milled cereals are poor sources of this mineral Table 37

TABLE 37

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 0 8 GM CALCIUM

FOODS	APPROXIMATE AMOUNT
Milk	3 cups
Cottage cheese (from skim milk)	3 cups
Cheddar cheese, grated	1 cup
Egg, raw, whole	30 each
Liver, beef, fried	20 pounds
Beef, round, without bone	16⅗ pounds
Kale, cooked	3½ cups
Cauliflower, cooked	30 cups
Dried prunes, uncooked	160 large

part

shows the varied amount of foods fairly rich in calcium which will supply the recommended allowances of an adult woman

During periods of growth, the calcium need is high, as indicated in Table 36 The need in adolescence is often neglected Also, during pregnancy the calcium requirement is increased, and while lactating, it should be even higher It is important for the health of both the baby and the mother that adequate amounts of calcium are supplied by food at this time

Phosphorus is also a major constituent of the bones and teeth, approximately 80% of the amount in the body is found in the skeletal tissues The remaining 20% is distributed in combination with proteins, lipids, carbohydrates, and in organic compounds Phosphorus is a constituent of every living cell The phosphates (salts of phosphorus), especially the sodium and potassium salts, are important factors in maintaining the neutrality of body fluids (see discussion of Acid Base Balance later in this chapter)

It has been said that compounds of phosphorus have a greater variety of function than any other nutrient In addition to the

previously mentioned roles, they are involved in the metabolism of proteins, fats, and carbohydrates of muscles, nerve, and brain, and in vitamin and enzyme activity

As indicated previously, calcium and phosphorus are essential for bone and tooth structure Approximately 85 per cent of the skeletal tissue is calcium phosphate Vitamin D regulates the utilization of calcium and phosphorus and is, therefore, essential for normal bone tooth structure The interrelation of calcium



Fig 47 —Rats from the same litter 22 weeks old The first rat did not have enough calcium It weighed 91 gm Note the short stubby body due to poorly formed bones The second rat had an abundance of calcium and weighed 219 gm Its bones are well formed (Courtesy Bureau of Home Economics United States Department of Agriculture)



Fig 48 —Rats from the same litter 9 weeks old The first rat did not have enough phosphorus and weighed only 60 gm The second rat had an ample supply and weighed 115 gm (Courtesy Bureau of Home Economics United States Department of Agriculture)

to phosphorus also is such that if either element is low, the other is not normally utilized, even though it be present in an adequate amount When either of these minerals is lacking, such conditions may occur as stunting of growth, deformities, and rickets (a deficiency which can also result from inadequate amounts of vitamin D)

Concerning the allowance for phosphorus in the diet, the Food and Nutrition Board stated " The evidence indicates that the

phosphorus allowances should be at least equal to those for calcium in the diets of children and of women during the latter part of pregnancy and during lactation For other adults the phosphorus allowances should be approximately one and one half times those for calcium '

Phosphorus occurs in foods as a phosphoprotein in the casein of milk as a nucleoprotein in the ovovitellin of egg yolk as a phosphorized fat (phospholipid) lecithin and as phosphoric esters (salts) of carbohydrates etc Milk is an important source of phosphorus (one quart contains 0 9 gm) and meat fish fowl egg vegetables (especially the flowers and seeds) fruits nuts and cereals contribute good amounts It is generally believed that if the diet is adequate in calcium and protein the needs for phosphorus will be supplied

Iron is the third mineral for which calculation is made in dietary studies or dietary adjustments Even though only small amounts are required daily (the entire body contains not more than 3 to 4 gm) that small amount is of tremendous importance

Interest has centered around iron metabolism and while there are many gaps in the understanding some data are available The small reserve is carefully conserved only small amounts are excreted and the rest is largely salvaged and reused This fact explains why a more widespread incidence of anemia does not exist Iron deficiencies can occur and do when the need is increased without increased intake as in infancy when the liver reserve is gone and the dietary intake is not yet adequate in childhood where blood formation is going forward and as a result of menstrual losses pregnancy or hemorrhage

It is interesting to know that if calcium intake is abundant iron equilibrium may be established at a lower level Calcium is said to exhibit a synergistic (supplementing or cooperating) action toward iron Copper likewise exerts this synergistic action Whipple and his associates conclude from their studies that a proper total mineral balance results in more effective utilization of iron

When iron intake is inadequate or the body reserves are depleted a specific anemia results Hemoglobin which gives blood its red color contains iron It has the ability to form a loose

chemical combination with oxygen from the inspired air in the lungs, and thus it is carried to all tissues by the circulation When iron is low, hemoglobin is low, tissue oxidation is below normal as a consequence, and weakness and depression ensue

It is known that the individual can absorb ferrous iron more readily than ferric Ferric iron is reduced in the human stomach to ferrous and it is then absorbed in the small intestine Recently, it has been suggested that man can control the amount of iron absorbed The regulation of iron absorption also has been shown to be dependent upon the needs of the body for iron, the amount being increased in animals and man deficient in iron

The recommended allowances for iron for all ages are based upon information from present day research In some instances, recommendations for a given age group have been suggested by the accepted needs of another age level (See Table 38)

TABLE 38

RECOMMENDED DAILY DIETARY ALLOWANCES FOR IRON
Food and Nutrition Board National Research Council, Revised 1953

	AGE YR	WEIGHT KG	(LB)	HEIGHT CM	(IN)	IRON MG
Men	25	65	(143)	170	(67)	12
	45	65	(143)	170	(67)	12
	65	65	(143)	170	(67)	12
Women	25	55	(121)	157	(62)	12
	45	55	(121)	157	(62)	12
	65	55	(121)	157	(62)	12
	Pregnant (3rd trimester)					15
	Lactating (850 ml daily)					15
Infants	0-1/12*					
	1/12-3/12	6	(13)	60	(24)	6
	4/12-9/12	9	(20)	70	(28)	6
	10/12-1	10	(22)	75	(30)	6
Children	1-3	12	(27)	87	(34)	7
	4-6	18	(40)	109	(43)	8
	7-9	27	(59)	129	(51)	10
Boys	10-12	35	(78)	144	(57)	12
	13-15	49	(108)	163	(64)	15
	16-20	63	(139)	175	(69)	15
Girls	10-12	36	(79)	144	(57)	12
	13-15	49	(108)	160	(63)	15
	16-20	54	(120)	162	(64)	15

*See Table 3 for explanatory footnote

The iron of milk is in a readily available form but is low in total content there being only 2.4 mg. *of iron per quart* This is only a fractional part of the day's requirement of the adult which is set at 12 mg by the Food and Nutrition Board of the National Research Council To compensate for the low iron content of milk *the young whose early diet is milk, are born with* an extra supply of iron in the liver The iron content of the baby's liver at birth is three times that of an adult an amount which will supply enough iron for the first six months of life

Certain foods notably liver gizzard kidney apricots peaches and prunes while rich in iron are effective out of proportion to their iron content in promoting blood regeneration in dogs made anemic by bleeding Substances other than iron are present in *these foods and give them added effectiveness* Today many cereal products such as bread macaroni rice and cereals are enriched with iron as well as with thiamine riboflavin and niacin

TABLE 39

AMOUNTS OF VARIOUS FOODS NEEDED TO SUPPLY 12 MG OF IRON

FOODS	APPROXIMATE AMOUNT
Liver beef fried	5½ ounces
Beef round without bone	12 ounces
Pork loin without bone	14 ounces
Milk whole	17 quarts
Egg raw whole	10 (each)
Molasses medium	10 tablespoons
Kale cooked	5 cups
Bread white enriched 2% nonfat milk solids	120 slices
Bread whole wheat	24 slices
Oatmeal cooked	7 cups
Split peas	1⅓ cups

Adapted from *Composition of Foods Raw Processed Prepared* U S Department of Agriculture Handbook No 8

Iodine is necessary only in minute amounts 0.002 to 0.004 mg daily for each kilogram of body weight This small amount is however essential Iodine is used in the manufacture of the *secretion of the thyroid gland thyroxine* With insufficient outpouring of thyroxine there is decrease in metabolic rate since thyroxine stimulates the oxidative processes in the tissues When insufficient iodine is ingested enlargement of the thyroid gland *(simple goiter)* results (see Chapter 10)

Goiter is prevalent in specific areas called goiter belts where the iodine content of the environment is low Sea water is rela

tively rich in iodine and therefore, as far as the salt spray can reach, or salt water seepage can go, iodine is adequately supplied by vegetables grown in those regions. Due to variability in environmental conditions, the minute traces of iodine found in foods, and the difficulty of analysis, reliable data as to food content of iodine are not available. Excess iodine can be stored in the body for future use, and experiments have proved that the administration of small amounts twice yearly for a period of two weeks to a month is good protection against goiter development. Iodized salt, which contains one part either potassium or sodium iodide to 5,000 parts salt, has had widespread use as a source of iodine. Such a product is used with safety to prevent simple goiter, but for the overactive thyroid it might be dangerous. Iodine treatment of goiter should always be carried out under medical supervision. Goat's milk, fish, and other salt water products have a fairly high content of iodine, 100 to 400 parts per billion of dry food. Vegetables grown in nongoitrous regions, where iodine is a constituent of the soil, are fair sources of the element.

Sulfur enters the body as the amino acids cystine and methionine, components of the protein molecule. Approximately 1% of protein is sulfur; therefore if protein intake is adequate, the sulfur will likewise be adequate. Sulfur plays an important part in the oxidative process of the body through the medium of glutathione, a sulfur compound. Sulfur is a constituent of hair and nails. Insulin, the secretion of the pancreas which governs carbohydrate metabolism, is a sulfur compound, and vitamin B_1, or thiamine, and biotin contain it. To a lesser extent, sulfur is ingested as inorganic sulfate. Milk, whole grains, eggs, meat, peas, and beans are good sources of sulfur.

Sodium and **potassium**, while important constituents, require calculation to insure quantitative intake only in certain conditions, such as Addison's disease and cardiovascular disturbances. Sodium and potassium are seldom lacking in food; in fact, they are usually consumed in excessive amounts. Sodium is present in higher quantities in body fluids, potassium in the body tissues and in liquids secreted by glandular organs, for instance, milk. These two minerals are not interchangeable; in fact, preponderance of either results in a disturbance in the water balance of the body. They function with calcium in regulating muscu

lar irritability (See Appendix for data on the extent to which these minerals occur in foods also the discussion in Chapter 29 under Hypertension)

Sodium chloride (NaCl) is the largest constituent of mineral matter of the blood Its presence is of utmost importance in regulating water balance In an ordinary diet the average individual ingests from 10 to 15 gm daily an amount far in excess of his needs Five grams is a liberal allowance unless sweating is profuse

When NaCl elimination is retarded for any reason it follows that water will also be retained by the tissues in an effort to have the salt solution of the tissue fluids of proper concentration This water retention has distinct disadvantages It may therefore be necessary at times to limit the intake or to reduce it to a minimum In such instances the salt may be reduced to 2 to 4 gm Shohl suggests 4 gm is an approximate maintenance level Reduction may be brought about by eliminating all salted foods using no salt except the small amount needed in the preparation of food avoiding salted butter salted nuts salted crackers etc This is described in Chapter 39 A very low level may be dangerous since some sodium and chlorine are absolutely essential and if continued too long drastic restriction will result in mineral imbalance and loss of appetite will inevitably result because of unpalatability of the diet This may lead to malnutrition and further body dysfunction due to deficiencies *Patients on low NaCl intake should be under strict medical supervision* Conversely when profuse sweating prolonged vomiting or severe diarrhea have resulted in excessive salt loss to the body extra salt should be provided to prevent tissue dehydration

Salt (NaCl) restriction is practiced less today than sodium restriction It has been found that it is the sodium ion and not the chloride which is the offender in water retention (400 mg sodium is equivalent to *approximately* 1 gm NaCl)

Chlorine The major part of chlorine is combined with sodium to form sodium chloride Chlorine as chlorides particularly sodium chloride is present in all secretions excretions and body tissues The hydrochloric acid of the stomach arises from chlorine supplied to the gastric glands by the blood The chlorides are among the most important of the body regulators They control the osmotic pressure of body fluids and thereby control

the passage of water in and out of body tissues. This is a point of great importance in dehydration, where tissue water is greatly reduced, and in edema, where tissue water is greatly increased.

Magnesium is present in the chlorophyll or green coloring matter of plants and forms approximately 1% of bone and tooth structure. It is present also in all soft tissue and in body fluids. On a diet containing an adequate intake of plant and animal food the magnesium requirement is easily met. However, if animals are maintained for a period of time on a diet devoid of magnesium, there is an increase in heartbeat, blood vessel dilatation, increase in irritability, and finally convulsions and death. Magnesium, therefore, is essential to life, although in just what manner has not been established.

Manganese is another element known to be essential to life, although its specific function is unknown. However, sterility in male rats and lack of maternal instinct in female rats, and a leg deformity in chickens (perosis) develop when manganese is withheld from the diet.

Copper is in general so closely associated with iron that adequate intake of iron assures adequacy of copper. Liver, oysters, molasses, chocolate, and cocoa are all excellent sources of copper. The 1952 recommended allowances suggest 1 to 2 mg daily—approximately one tenth that for iron. Copper is an important factor in the utilization of iron for the formation of hemoglobin rather than as a constituent of hemoglobin. McLester suggests that it does not influence the assimilation of iron but acts merely as a catalyst in the transformation of this element into hemoglobin, thus giving it a function unique among the metals.

Fluorine has recently been studied with interest in connection with tooth disorders, in particular the mottled enamel known as fluorosis. In some cases excess fluoride has been to such a great degree that it has apparently interfered with the normal calcification of the teeth so that they become structurally weak. The fluorine content of water in some localities is high enough to bring about such changes. This is an instance where excess rather than a deficiency is serious. However, fluorine intake below a minimum level may be a contributing factor in dental caries. (See discussion in Chapter 14.)

Cobalt, bromine, aluminum, zinc, and other elements are found in very minute amounts. They are spoken of as trace elements and their specific functions are unknown. The determination of the formula for vitamin B_{12} revealed the fact that cobalt is a constituent of that vitamin. However, to date, a human requirement for cobalt apart from *its relationship to vitamin B_{12} has not been* determined.

Shohl suggests the approximate daily requirements for the normal man as given in Table 40.

Table 40

Na	4.0 gm	P	1.3 gm	Fe	12.0 mg
K	2.5 gm	S	1.3 gm	I	0.1 mg
Ca	0.8 gm	Cl	6.0 gm		
Mg	0.3 gm				

Acid Base Balance

The subject of acid base balance is one of complicated chemistry and must appear so in spite of an effort to simplify. The simplest solution may be to omit it, however, *for the sake of the over all coverage of the subject of nutrition, it seems wise to include a brief survey for those who desire to read it.*

In discussing the minerals, it has been pointed out several times that they function to regulate the blood neutrality and to maintain the acid base balance of the body. The elements calcium, sodium, potassium, and magnesium are alkaline. Phosphorus, sulfur, and chlorine are acid. The preponderance in a food of one group over the other is the deciding factor in determining whether that food will, after metabolic breakdown is complete, yield an acid or an alkaline (basic) ash, or will result in an acid or alkaline urine, inasmuch as these constituents which are not taken up by the body are largely eliminated through the kidneys in the urine. *Milk, fruits, and vegetables are base forming, cereals, meats, and eggs are acid forming.* It seems paradoxical that foods containing the fruit acids are reduced to an alkaline ash in the process of utilization but this is quite true. Occasionally, as for instance in prunes, cranberries, and plums, an acid not utilizable by the body is present in sufficient amounts to mask the alkalinity of the minerals in the food and the food then produces an acid urine. The degree of acidity or alkalinity

TABLE 11

PRINCIPAL MINERALS—THEIR FUNCTIONS AND IMPORTANT SOURCES

MINERALS	FUNCTION	DEFICIENCY SYMPTOMS	PRIMARY SOURCES
Calcium	Essential for bone and tooth formation Essential for clotting of blood Aids in regulation of nerve and muscle action Essential for normal heart action	Poor bone and tooth formation	Milk Cheese, American Kale Egg yolk Greens, mustard and turnip
Phosphorus	Essential for bone and tooth formation Essential for metabolism of protein, fats, and carbohydrate Constituent of every cell in body	Poor bone and tooth formation Impaired food metabolism	Milk Cheese, American Eggs Legumes Meats and fish Nuts
Iron	Essential for formation of oxygen-carrying hemoglobin of the blood Essential in cell metabolism	Some types of anemias	Liver Lean meats Egg yolk Legumes Enriched breads and cereals Green leafy vegetables
Copper	Essential for metabolism of iron Used as coloring in hair and skin	Produced in animals	Legumes Liver Meats Whole grain cereal and bread
Iodine	Essential for normal functioning of the thyroid gland	Simple goiter	Sea foods Plants grown in soil near sea Iodized salt
Sodium	Aids in regulation of water balance Aids in maintaining acid-base balance Essential for muscle contraction	Unknown	Table salt Salted fish and meats Canned meats, fish, vegetables Cheese Milk Margarine
Chlorine	Aids in regulation of water balance Aids in maintaining acid-base balance Constituent of gastric digestive secretion (HCl)	Unknown	Table salt Salted fish and meats Olives Canned meats, fish, vegetables

of a food is expressed in terms of the quantity of normal acid or alkali to which it is equivalent (see Chapter 38, Table 108)

Blood and body tissues are nearly neutral in reaction (pH 7 4) When a solution is exactly neutral, it is said to have a pH (hydrogen ion concentration) of 7 0 Below this value, i e, pH 6 0, 5 0, etc, the solution becomes increasingly acidic, and above it, at pH 7 5, 8 0, etc, it becomes alkaline The designation pH is used to express the balance between acid and alkaline elements However, if the blood pH reaches 7 0 in the body, acidosis is present, and at 7 8, alkalosis The ability of the blood to be held within such a narrow pH range is due largely to the blood buffers This constancy is maintained in spite of wide variation in the pH of urine Urine may be acid or alkaline In addition to the buffers, two other factors are operative in maintaining this balance—the lungs and the kidneys

Food, after digestion, is carried to the tissues where it is oxidized The organic material which is not needed immediately is changed to carbon dioxide and water, and the mineral elements are set free The acid radicals (elements) are immediately neutralized by alkaline radicals, if both are set free simultaneously If not set free at the same time, they are neutralized by the **alkali reserve** At all times there is an excess of alkali (largely sodium bicarbonate) held in the body as reserve alkali When alkaline radicals in excess of those used to neutralize the acid radicals are released, they are added to this reserve store This supply may be called upon at any time to release alkali for the neutralization of acid When this need arises the carbonic acid salts (carbonates) of the alkaline elements react with the circulating acid in such a way as to tie up that acid and release the weak carbonic acid This carbonic acid is immediately and readily eliminated through the lungs as carbon dioxide and water Obviously, if a diet devoid of sodium is ingested, the alkali reserve is depleted, and with this major buffer removed, the blood acid increases and acidosis probably results

The term acidosis is loosely used True acidosis is rare In correct usage of the term only an upset in acid base (alkali) balance of the blood results in acidosis When an acidosis results from an incomplete combustion of fat, it is a ketosis (the acidosis of diabetic coma)

The blood neutrality is further maintained by the action of other buffers which are capable of tying up with free radicals, namely, the phosphates amino acids, and proteins

In addition, the kidneys may produce varying amounts of ammonia, which also functions to maintain neutrality

See Chapter 38 for a detailed table of the acid or basic effect of foods

Review Questions

1 Of the many minerals important in human nutrition, what three require special calculation in the dietary? Why these three?
2 How do minerals function in the body?
3 What special functions does calcium fill? Phosphorus? Iron?
4 What is the standard daily amount recommended for an adult for each of these minerals?
5 What is the richest food source of calcium? Other good sources?
6 What foods contribute phosphorus? Iron?
7 Does age or sex affect the amount of these minerals needed?
8 What other minerals are necessary to human nutrition?
9 What minerals produce an acid ash after metabolic breakdown? What ones are alkaline?
10 What foods are acid forming? What base forming?
11 How is the neutrality of the blood and body tissues expressed?
12 What mechanism keeps the body tissues neutral or nearly so?

Suggested Projects

1 Examine your own menus Calculate the calcium content in one or two days' menus Did the amount of calcium included in your diet meet the recommended allowance for your age group? If not, why not? What changes can you make that will insure your obtaining adequate calcium?
2 From the calculations obtained in No 1 what per cent of the calcium in your diet comes from milk? From milk products?
3 Assuming that an adult dislikes milk, or does not include it in his normal eating pattern, how may he obtain his calcium? In what other forms will it be acceptable to him? Be sure that your suggestions are a pratical solution to the problem
4 Assuming that a teen age girl dislikes milk Plan menus for her that will meet her nutritive needs yet be a diet she will follow, and do not include milk as a beverage in her diet
5 Examine your own menus Calculate the iron content in one or two days' intake Did the amount of iron included in your diet meet the recommended allowance for your age group? If not, why not? What changes can you make that will insure your obtaining adequate iron?
6 From the calculations obtained in No 5, what per cent of the iron in your diet came from enriched products?

of a food is expressed in terms of the quantity of normal acid or alkali to which it is equivalent (see Chapter 38, Table 108).

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Food, after digestion, is carried to the tissues where it is oxidized. The organic material which is not needed immediately is changed to carbon dioxide and water, and the mineral *elements are set free. The acid radicals (elements) are immediately* neutralized by alkaline radicals, if both are set free simultaneously. If not set free at the same time, they are neutralized by the **alkali reserve.** At all times there is an excess of alkali (largely sodium bicarbonate) held in the body as reserve alkali. When alkaline radicals in excess of those used to neutralize the acid radicals are released, they are added to this reserve store. This supply may be called upon at any time to release alkali for the neutralization of acid. When this need arises, the carbonic acid salts (carbonates) of the alkaline elements react with the circulating acid in such a way as to tie up that acid and release the weak carbonic acid. This carbonic acid is immediately and readily eliminated through the lungs as carbon dioxide and water. Obviously, if a diet devoid of sodium is ingested, the alkali reserve is depleted, and with this major buffer removed, the blood acid increases and **acidosis** probably results

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11 How is the neutrality of the blood and body tissues expressed?
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6 From the calculations obtained in No 5, what per cent of the iron in your diet came from enriched products?

CHAPTER 14

THE RELATION OF NUTRITION TO THE TEETH

Nutrition has been shown to be of primary importance in the formation of sound teeth The diet of the mother prior to and during the prenatal period and the food habits of the young child supply necessary nutrients Dental caries is widespread, with an especially high incidence among children and young adults The cause of this condition is debated Several theories have been advanced which are thought to be effective in controlling caries Dietary management may be of value

The interest today in nutrition as it relates to the teeth is two fold of primary importance is the role that various nutrients play in the formation of sound teeth and healthy supporting structures, and, equally as important, is the possible influence that foods and nutrition may have in reference to dental caries It is impossible to discuss one without considering the other as many investigators believe that the former has a determining effect upon the latter The incidence of dental caries is so wide spread that it is considered a menace and a public health problem

It is currently believed by many that nutritional status of the mother before conception has an important effect upon the health of both the child and the mother (see Chapter 18) This may also have an influence upon the development of the teeth of the fetus as well as a strong healthy body Also, if the mother has established good nutritional habits for herself, the young child will probably be used to a well balanced diet pattern

Prenatal conditions affect the first set of teeth The tooth buds for the deciduous teeth (the "baby teeth") are distinguishable at the eighth week of prenatal life Both the dentine and enamel are thought to begin calcifying about the fourth fetal month (See Fig 50 the cross section of a tooth) By the time the child is born the sixth year molars (the first of the permanent teeth to erupt) are beginning to calcify, hence, it is obvious that if teeth are to be perfectly developed, structural material for them must be adequate during prenatal life Minerals

vitamins especially an adequate amount of vitamin D, and amino acids are primarily needed If this material is not supplied by the mother's food, her body stores will be called upon, these may not be equal to the nutritional needs This may be



Fig 49 Relation of blood supply to structure of the teeth The black lines represent the blood stream which supplies the teeth with food (From If Food Could Talk Cornell University Bulletin J 44)

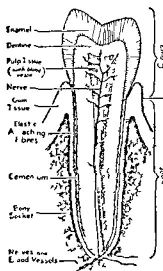


Fig 50—Cross section of a tooth Each tooth is composed of three parts the crown above the gumline the roots below and the neck where crown and roots meet The crown is covered with enamel the hardest material in the body and the *roots are covered with a thin layer of bonelike material called* dentine which lies underneath these outer coverings Enclosed with the dentine is a hollow space called the pulp chamber where the life of the tooth is maintained (Courtesy Metropolitan Life Insurance Company)

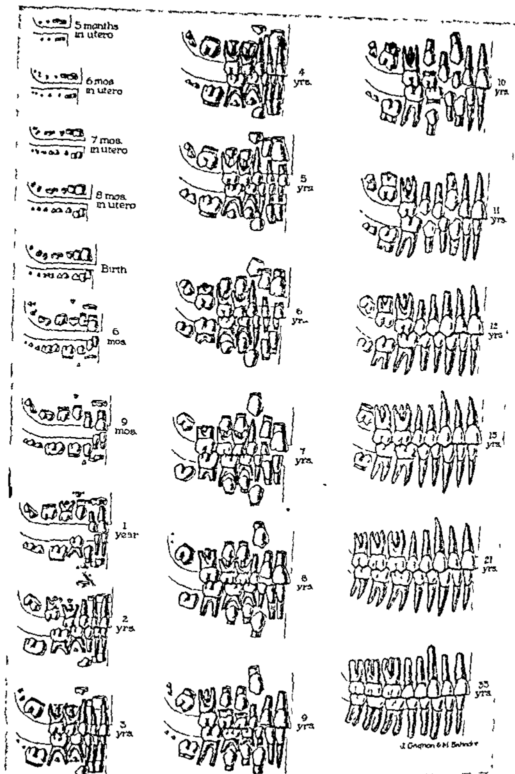


Fig. 51 —Development of the human dentition (Courtesy Dr I Schour and Dr M Massler, University of Illinois, College of Dentistry)

a distinct disadvantage to the tooth development of the child and to the tissues of the mother.

Mellanby showed that in dogs the improper feeding of the mother during pregnancy had a deleterious influence upon the tooth structure of the young. The work also tends to show clearly that a diet which will produce rickets also tends to interfere with proper calcification and enameling of the teeth. Pregnant sows, on the other hand, were found by Klein, McCollum, Buckley, and Howe to make sufficient sacrifice of their own reserves to insure normal teeth to the young at birth.

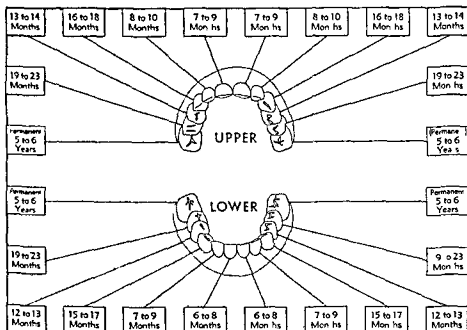


Fig. 52.—Baby's first teeth. (Courtesy California Fruit Growers Exchange.)

Thus the tooth is now believed to be a living structure and as such must have adequate nourishment for growth. Any wide departure from an adequate diet appears to be reflected in tooth health or tooth setting, since the surrounding gum tissue must be considered with the teeth proper. Fig. 51 represents a schematic development of the human dentition both prenatally and postnatally.

Specific dietary deficiencies have been shown to result in specific changes in the teeth, as indicated by vast data which have

been accumulated Vitamins A, the B group, and C, in addition to vitamin D, as well as calcium and phosphorus are shown to be essential for development of normal tooth structure, but not in amounts greater than those ingested in the normal adequate diet, with the exception of vitamin D.

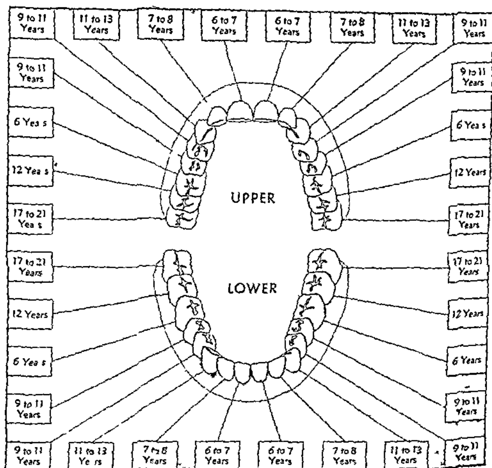


Fig 53.—The permanent teeth (Courtesy California Fruit Growers Exchange)

In summarizing the role of the diet in the formation of the tooth and in its relation to the possibility of later development of dental caries, Leicester has observed "There is good evidence that the structure of the tooth itself may play an important part in determining whether the tooth will subsequently resist attack by microorganisms The structure is determined either by conditions which prevailed in the organism when the tooth was formed or by posteruptive changes in composition and structure"

Many surveys have revealed the great extent to which dental caries exist as a disease. From the present information gathered by such surveys it has been estimated that half of all 2 year old children have one or more decayed teeth, less than 25 out of every 100 high school pupils are free of decayed teeth, and at 16 the average youth has seven decayed, missing or filled teeth involving 14 tooth surfaces. These are startling data. Today, research is directed toward discovering means whereby this extremely high incidence of caries may be reduced once the teeth have been formed.



Fig. 54. Vitamin D deficiency affects the teeth. The lack of calcium, phosphorus and vitamin D affects the teeth. The 11 year old child had severe rickets when 8 months old [illegible] vitamin D. (Courtesy Wisconsin Alumni Research Foundation.)

Dienstein pointed out that our efforts are governed by two key words, control and prevention. According to him "control of dental caries indicates only a means of reducing the rate of dental caries formation, hence to a certain extent we can *control* caries. But to date there is no way to *prevent* caries." Recently there have been several methods suggested which are thought by many to be beneficial in decreasing caries

One, the use of *fluorine*, is concerned with tooth development Mottled enamel is characteristic of individuals living in districts where the fluorine content of the water is high The teeth appear dead white and unglazed, and are pitted, corroded, and structurally weak Curiously enough, however, field studies have shown that there is a lower incidence of caries in the areas of mottled enamel Rats have been shown to develop less caries on a caries producing diet when fluorine is added to the diet Fluorine seems to reduce both the acid production of the oral bacteria and the solubility of the dental tissues Data suggest that for children in the early years of life (the first eight), when *tooth formation is taking place, drinking of fluorine containing* water has definite effect in holding the incidence of caries to a level lower than that of children drinking water containing little or no fluorine It is believed that such caries resistance acquired during tooth formation continues through adult life, however, little evidence is available to support this latter contention

The use of fluorine during tooth development may occur in two ways One has been the incorporation of fluorine in the drinking water The U S Public Health Service has added fluorine to the drinking water of several communities and used other communities as controls in order to determine the effectiveness of this method Preliminary reports indicate that it is a practicable and partial solution to caries control Other communities have voluntarily artificially added fluorides to the public drinking water

It had been found that when water contains one part per million of fluorine the "critical" point is reached between mottled enamel and reduction of caries More than this concentration produces mottling and appears to have no greater protective value against decay Accordingly, this (1 part per million) is the accepted optimum level of concentration

Objection has been raised by some to this practice on the basis of the toxicity of fluorine Fluorine is highly toxic in large amounts (Rodent poison is a potent source of fluorine) A single massive dose—roughly 10 gm —may be fatal within hours However in the extreme dilution of 1 part per million, not the slightest toxic effect could be had regardless of the amount of water drunk A toxic dose of roughly 10 gm would require the

ingestion of 2 500 gallons of water fluorinated to the extent of 1 part per million (1 gm in 2 0 gallons) within a few minutes of time

A second method of incorporating fluorine in the formation of the tooth is its use by the practicing dentist A 2% solution is applied by the dentist at stated intervals (usually weekly for four weeks) directly to the dried surfaces of the tooth A variety of results have been reported as it seems to reduce caries in some children whereas in others it is ineffective

Another method which is suggested in caries control is through diet restriction This school of thought explains the incidence of dental caries on the basis of a chemicoparasitic theory namely that there is localized destruction of first the enamel and then the dentine due to acid products of fermentation of carbohydrate foods resulting from microorganism activity chiefly *Lactobacillus acidophilus* Bunting one of the early supporters of this latter theory believes that continuous action of this sort will eventually affect even the strongest teeth Decrease in carbohydrate intake especially sweets coupled with proper brushing and the filling of pre carious pits which can readily become little lactic acid factories have been shown by experimenters belonging to this school to result in a decrease in the incidence of caries

Blayney director of the Zoller Dental Clinic of the University of Chicago feels that corrective measures have failed the dental profession is totally unable to halt tooth decay by the placement of fillings Preventive steps are imperative if progress is to be made He too is convinced that the mineral salts of the teeth are removed and decay is started by the presence of an acid on the tooth surface thus giving support to the chemicoparasitic theory He believes that it is not necessary for the food particles themselves actually to remain on the teeth passage of fermentable material through the mouth is sufficient The American people especially the American youth consume much more sugar than dietary standards suggest A report published in 1946 by the Department of Agriculture (Bureau of Agricultural Economics) estimated that 713 000 tons of sugar were used in bottled beverages within that year and that candy utilized 491 000 additional tons Soft drinks are approximately 10% sugar solutions The food patterns of Americans of all ages in

dicate that sweets, sweet drinks, sweet pastries and sweetened coffee are frequently consumed between meals. This practice may be a factor in constantly reinforcing a relatively high local acidity and thereby contribute to a caries-producing environment.

Thus, it is believed that by restricting the injudicious use of sugar and highly fermentable foods dental caries may be controlled. All too frequently these foods reduce the desire for the more important foods and natural sugars. If the child eats the proper amounts of foods which provide the recommended allowances of essential nutrients, he will have little time or appetite for undesirable *snacks. In between feedings should be a planned* part of the daily menus (see Chapter 20), and if sweets are not given as rewards for good behavior, their desirability may be *diminished. Parents can establish good food patterns in children* so that they will not need to rely on frequent intakes of concentrated sweets in order to obtain the calories necessary for growth.

Dr. Genevieve Stearns has offered an interesting possibility which deserves consideration when dental caries persist in spite of an apparent adequate dietary intake. In discussing mineral nutrition, she reports several cases. Briefly, one case: A 14-year-old girl came to the clinic "because of sudden and devastating dental caries—some 26 cavities appeared within a few months." Clinical examination gave no clue. Metabolic study indicated that calcium and phosphorus were not retained in spite of an adequate diet. The vitamin D intake was also satisfactory. The girl's vitamin A status was measured and found to be subnormal. Evidently, vitamin A absorption was below par; if so, vitamin D absorption should likewise be below par. Bile salt therapy was instituted in order to facilitate fat absorption. Within a few days, calcium and phosphorus retention returned to normal, the vitamin A status was improved, and the caries were arrested. Failure to utilize dietary vitamins A and D may well be subjected to further investigation.

An interesting suggestion came from Gottlieb who was at Baylor College of Dentistry. He pointed out that teeth are unique in that unlike the rest of the body they lack a layer of protective epithelial tissue which is constantly sloughed off and renewed, thereby protecting the underlying tissue from invasion

Teeth instead have a hard sheet of enamel which covers the underlying dentine. Why this hard protective coat should be vulnerable to bacterial invasion has been a puzzling question. The attack by acid seemed a solution and the production of the acid by bacterial action on carbohydrates logical, but in assuming that bacteria are the cause they are "mistaking an effect for a cause." In the opinion of Gottlieb, the explanation lies in the fact that organic threads (lamellae) of noncalcified material run through the enamel. These represent 5% of the enamel. This fact has been known since 1878 but its significance not appreciated. The longer of these threads extend from the outer surface to the inner dentine which is only 33% calcified. It is through these lamellae that bacteria "under favorable conditions for them" reach the dentine where decay can proceed. This accounts for the extent of decay which sometimes is present in spite of an apparently intact enamel. Perhaps in time the cause of the bacterial invasion will be found, but in the meantime Gottlieb proposes to "close the lamellae against invasion." He accomplishes this by precipitating an insoluble salt within them. A chemical compound (a zinc chloride potassium ferrocyanide salt) placed upon the teeth at appropriate intervals impregnates the lamellae and produces block. With these treatments Gottlieb has reduced the dental caries in 90% of his cases.

He challenges the theory that fluorine acts through inhibition of acid; he suggests instead that it acts rather by attracting calcium to itself in the lamellae, thereby forming an insoluble salt block.

If one considers the evidence, it seems sensible to take a middle course to fight dental caries with personal and professional care of the teeth and the ingestion of a diet containing adequate calcium, phosphorus, vitamins A, B group, D and C, and *carbohydrate in moderation*. To assure these substances the diet should include the daily quart of milk, one egg, a glass of citrus fruit juice or some other potent source of vitamin C, at least one other fruit or raw green leafy vegetable, a generous serving of butter or margarine, and a fish oil of some kind unless the diet is fortified or unless irradiated milk containing 400 U.S.P. units of vitamin D is used. Candy should be curtailed and simple desserts or fruits should replace the sweet and rich dishes. The curtailment of carbohydrate will naturally result in a compensatory

increase in fat if the caloric level is kept constant This type of diet has been reported to be beneficial in promoting tooth health In fact, it is the diet which should promote optimum nutrition In other words, adequate structural material during the period of tooth formation with protection of the teeth by curtailment of sweets—especially sticky sweets—and the careful removal of film with its possibilities for bacterial action after eating should be the basis of tooth care

It must be kept in mind that the actual cause for dental caries is unknown There are many influences beyond the scope of the present discussion which may be contributing factors, such as heredity, the composition of saliva, and the actual mechanism whereby an area of the tooth decays It is generally accepted, however, that the health of the tooth and its surrounding structures *is closely related to the health of the individual* It is believed that good nutrition can profoundly affect the formation of the teeth and probably is a major factor in maintaining sound teeth

Review Questions

1 What is the relationship between prenatal nutrition and strong teeth?
2 What nutrients have specifically been shown to be essential for normal tooth structure?
3 How may the terms "control" and "prevention" be used in speaking of dental caries?
4 What theories have been suggested concerning nutrition and dental caries?

Suggested Project

1 Examine your own menus Does your food pattern resemble any that was discussed in the preceding pages? Evaluate

CHAPTER 15

WATER BALANCE

Although not considered as a nutrient by many, water is extremely important to health Loss of small amounts of water may result in serious complications Water is obtained in several forms as a beverage, as preformed water and through metabolism Water is lost from the body in three ways, in the urine through evaporation, and in the feces The water regulating mechanism, thirst, is so effective that the individual normally obtains enough water for his metabolic needs

Approximately three quarters of the body weight is due to its water content and in the opinion of Peters and his co workers about one third of this is extracellular (outside the tissue cells) and two thirds is within the cell itself Disturbances of this equilibrium may be serious Water balance studies are steadily assuming importance Water has greater importance than any of the foodstuffs It is second only to oxygen Life can go on many weeks without food, but cannot be maintained even half a week without water In fasting, practically all of the body fat and half of the body protein may be lost before death occurs

Loss of 10% of the body's water results in serious disorder, a loss of 20% results in death Death from water loss is not due to actual decrease as such but to the upset in all of the metabolic processes due to the decreased availability of water Every cell requires water both for structural existence and function

Water is the basis of blood, which is the vehicle of transport within the body By way of the blood, food supplies and oxygen are carried to the tissues and waste products including carbon dioxide are carried away to their port of exit By means of its elimination through the skin, water is a factor in heat control It is the solvent for urinary solids With extreme water shortage or even sharp curtailment, kidney function is impaired Water is the solvent for the body minerals and so basically aids in all their functions (see Minerals Chapter 13) The tremendous value of adequate water, especially in illness is evidenced by the

much more rapid improvement when fluids are forced directly into the body tissues of those patients who are unable to take water by mouth in adequate amounts

Water is made available to the body in three forms, as beverages, as preformed water in foods (milk is 87% water, fruits 85%, and even dry cereals contain 10% water), and, finally, as the result of metabolic processes (metabolic water) When the body metabolizes food, water is one of the end points of the reaction, for example, Magnus Levy found that 100 gm of fat results in 107 gm of water, 100 gm of starch results in 55 gm of water, and 100 gm of protein in 41 gm of water This metabolic and preformed water is utilized by body tissues just as though it were ingested water

Water is lost from the body in several ways, by evaporation through the lungs and from the body surface, in the urine, and in the feces While the major part (500 to 3,000 c c) is lost through the kidneys as urine, the amount lost by other routes may at times be appreciable (in feces during diarrhea, etc) Soderstrom and DuBois outline a typical day (Table 42)

While at times it may be necessary to alter fluid intake, the average intake as fluids of from 1,000 to 2,000 c c daily is satisfactory To a large extent, salt (NaCl) intake regulates this ingestion

It has been suggested that a rough approximation of the water need may be made by allowing 1 c c for every calorie of expended energy As a rule, two thirds of this comes from food sources and one third is ingested as fluids

TABLE 42

Water Intake	Grams
Drinking water	300
Water in tea, coffee, etc	580
Water in solid food (preformed)	720
Metabolic water from protein (100 gm)	41
Metabolic water from fat (110 gm)	118
Metabolic water from carbohydrate (244 gm)	135
	1 894
Water Output	
In urine	750
In feces	300
Vaporized from skin and lungs	700
	1 750

In general thirst which depends upon food and NaCl intake, on activity, and on temperature governs water intake. Water passes unchanged through the digestive tract and is absorbed largely from the intestinal tract. Only small amounts are absorbed from the stomach.

When more water is lost from the body than a corresponding amount of salt thirst is immediately felt as indication of need for water intake. When salt losses are greater than the equivalent amount of water which would be *necessary to maintain*

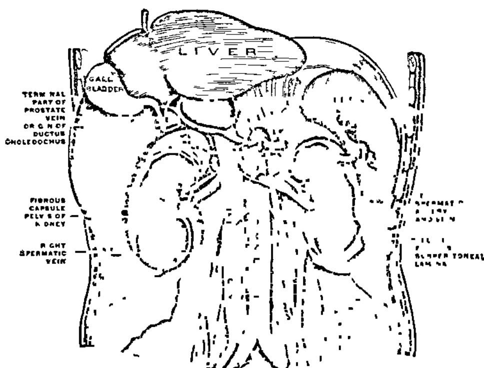


Fig. 50.—The kidneys and the urinary bladder. The two kidneys are shown within the body cavity. Their advantageous connections with the chief artery and vein of the system are indicated. Below is the bladder reached by the two ureters. These vessels enter the bladder down and behind, not at the level where they disappear from the figure. (After Sappey, from Gray's Anatomy, Lea & Febiger.)

the proper salt concentration of the tissues (the physiological salt level), characteristic symptoms develop—weakness and severe cramps, so-called heat cramps since they may occur as a result of excessive perspiration due to heat or violent exercise. Administration of oral salt is necessary to correct this condition. Water alone will not, even though great water loss has also taken place.

On a weight basis, children have a higher need for water than adults For example, the infant has a requirement three times that of the adult—his extracellular water is twice as high, his metabolic rate greater, and his kidneys less efficient Adequate fluid intake is especially *important in the early years* Dehydration takes place quickly in children (See Table 61)

Water intoxication, on the other hand, can result when excessively large amounts of water are forced The symptoms include nausea, vomiting, tremor, restlessness, *frequency of urination* and bowel movement, ataxia, convulsions, and coma

As indicated previously, the major portion of the water in the body *is lost through the urine* In order to appreciate the importance of the regulation of water metabolism and essential nutrients, a brief statement of the kidneys and their functions is in order

The kidneys are paired, bean shaped organs, about 4 inches in breadth and 1 inch in thickness, placed to the right and left of the vertebral column, just below the diaphragm The aorta and *inferior vena cava pass between them and assure them of* a copious supply of blood

Long, winding tubules, originating near the surface of the kidneys, can be seen microscopically These are secreting *units* conducting urine toward the concave border A knot of capillaries (glomerulus) appears at the beginning of each tube Traveling contractions (peristaltic waves) propel the urine *through the ureters into the bladder*

Urine is a yellowish liquid, colored by the substances related to bile pigments Under ordinary circumstances of diet and health, urine *is slightly acid It becomes alkaline,* however on standing, due to bacterial fermentation of urea and formation of ammonium carbonate As the result of the change, an ammoniacal odor develops and a cloudy deposit *may appear* About seven eighths of the nitrogen excreted in the urine is in the form of urea The remainder is divided among various other *nitrogenous* waste products, one of which is uric acid, a substance distinguished by its *scant solubility* and consequent tendency to be retained as in gout (see Chapter 33)

Inasmuch as all proteins contain sulfur, and some *contain phosphorus* and since *these leave the body* by way of the urine, phosphates and sulfates, in solution, are found there, *as well as con*

TABLE 43

THE WATER CONTENT OF VARIOUS FOODS

FOODS 100 GRAMS EDIBLE PORTION	PER CENT WATER
Apple, raw	84.1
Orange juice, fresh	87.5
Spinach, cooked	90.8
Ice cream, plain	62.1
Dried prunes, uncooked	24.0
Bread, white, enriched, 2% nonfat milk solids	34.5
Butter	15.5
Beef, round, cooked	51.0
Cheddar cheese	37.0
Corn flakes	3.6
Carrots, raw	88.2

Adapted from *Composition of Foods Raw, Processed, Prepared*. U. S. Department of Agriculture Handbook No. 8.

TABLE 44

PHYSIOLOGICAL CONSTITUENTS OF URINE*

Normal urine varies widely in composition, being influenced by diet and other factors. The following represents the composition of *average* normal daily excretion of the constituents.

CONSTITUENTS	AMOUNT IN GRAMS
Water	1200
Solids	60
Urea	30
Uric acid	0.7
Hippuric acid	0.7
Creatinine	1.2
Indican	0.01
Oxalic acid	0.02
Allantoin	0.04
Amino acid nitrogen	0.2
Purine bases	0.01
Phenols	0.2
Chloride as NaCl	12.0
Sodium	4.0
Potassium	2.0
Calcium	0.2
Magnesium	0.15
Sulfur total as S	1.0
Inorganic sulfates as S	0.8
Neutral sulfur as S	0.12
Conjugated sulfates as S	0.08
Phosphate as P	1.1
Ammonia	0.7

*From Hawk, Oser, and Summerson: *Physiological Chemistry*, ed. 12. Philadelphia, 1947. The Blakiston Company.

siderable amounts of sodium chloride *In addition, small amounts* of creatine, creatinine, hippuric acid, acetone bodies, and other constituents are present When any of these constituents exceeds in either direction the normal range found in health it assumes physiological importance and is of diagnostic value Such findings are indicative of the location and extent of metabolic dysfunctions

The blood, which is the precursor of these urine constituents likewise will reflect metabolic abnormality To maintain normal composition of the blood is the main function of the kidneys When the kidney function is impaired, there is accumulation of these constituents in the blood The reader is referred to Table 20, Chapter 10 and to Table 44 where the important constituents of blood and urine are listed with their physiological levels

The quantity of urine is influenced by many factors chief of which is the fluid intake, and next, the activity of the sweat glands It is important that, whenever possible, fluid intake be such that the dissolved solids in the blood, which are removed by the kidneys, shall have adequate solvent to facilitate the excretion from the body Between 1 and 2 liters of urine are normally excreted daily

Review Questions

1 Why is water of the greatest importance in the body?
2 What are the sources of water to the body?
3 What is another source in addition to food and fluid intake?
4 What is the total amount of water normally needed daily?
5 What percentage of body water could be lost before a serious effect would result?

Suggested Project

1 Examine your own menus for one day Calculate the amount of water found in the foods you ate How much of your water intake was preformed in foods and how much in the form of liquids? How many glasses of water do you drink each day?

CHAPTER 16

FOOD ADJUNCTS

A word about food adjuncts or those articles used in the diet which have little or no food value in themselves but which give flavor and add variety.

These adjuncts have a definite and important place and should not be eliminated from any diet unless such elimination is specifically necessary. Used in moderation they are not harmful, used in excess they may be irritating and may defeat their purpose by making foods less palatable. Even in the diet of the child and the invalid the use of adjuncts in *moderation* is justifiable.

Table salt is usually classified under this heading and to some extent it belongs there. The effect of NaCl on palatability needs no comment. Certain amounts moreover are essential to health (see Minerals).

Vinegar, a dilute solution of acetic acid (4%) and other substances giving it its flavor, adds savor to many otherwise flavorless foods. Pickling or the preservation of foods by the use of vinegar does, however, result in products less readily digested.

The **spices** owe their specific flavor to their volatile oils. Spices have been classified as stimulating condiments—cayenne, white and black peppers, mustard and horseradish. The aromatic spices include allspice, anise, cinnamon, caraway, cassia, clove, ginger, mace, nutmeg and the sweet herb group contributes dill, marjoram, sage, thyme and savory. Variety may be given to an otherwise monotonous diet by the cautious use of spices with perhaps temporary omission of the stimulating condiments during periods of gastrointestinal weakness.

Flavorings are available in great number. In general they are prepared by soaking or grinding into alcohol the flavor bearing product. Lemon and vanilla are the most commonly used extracts but those of aromatic spices are also procurable—almond, mint, attar of roses, wintergreen and others.

Tea, **coffee,** cocoa and chocolate belong to the food adjuncts. Certain of their components have caused much controversy as to

their inclusion in diets for other than the normal adult, and here, again, *moderation* and proper preparation of the brew are probably the answer There is little evidence that the daily cup of coffee with breakfast has any adverse effect, and it may make the difference between enjoyment and nonenjoyment of a meal It is certain that too often coffee is forbidden for no good reason Coffee consumption in the United States is high It has been estimated that more than half the coffee produced in the world is marketed in this country It is interesting to note that the consumption increased from 6 pounds per capita in 1909 to approximately 16 5 pounds per capita in 1952 In coffee, the important constituents are the alkaloid caffeine, caffetannic acid and the volatile oil caffeol Decaffeinated coffees (Sanka, Kaffee Hag), powdered soluble instant coffee, frozen soluble instant coffee, and coffee substitutes usually made from cereals are available on the market today

In **tea** the stimulating property is the alkaloid theine, which is identical with caffeine The flavor of tea comes from the tannin and a volatile oil The difference between green and black teas is in the preparation of the leaf for sale Black tea darkened by oxidative fermentation has its tannin changed to a more soluble form than that in the original green leaf

Excessive ingestion of the alkaloid and the tannin in either beverage results in overstimulation and irritation, and this should be avoided in health or in illness Caffeine is known to raise blood pressure, stimulate the renal activity, and bring about a mild cerebral stimulation It "clears the cobwebs" Coffee ingested with a meal slightly retards the emptying of the stomach and may thus increase the satiety value of the meal

Chocolate and cocoa differ in their fat content, chocolate having roughly twice as much fat as cocoa These two products likewise contain an alkaloid theobromine Excessive use of this alkaloid in the diet of children is contraindicated but, again moderation makes its use justifiable Theobromine is similar to caffeine but does not exhibit its stimulating properties

Recently there has arisen a popular idea that cocoa and chocolate have a marked effect on calcium utilization and that their addition to milk as in milk shakes, chocolate milk or cocoa is ill advised This is another example of scientific findings being

overemphasized It is true that cocoa contains oxalic acid and that oxalic acid ties up with calcium forming an insoluble salt which results in calcium loss to the body However, the amount of oxalic acid in cocoa and the amount of cocoa or chocolate in these drinks make the effect of the addition of little importance From the standpoint of habit formation plain or "white" milk probably is preferable but the argument for it on the basis of calcium loss is a bit farfetched

Soft drinks are in general, sweetened, flavored water which has been carbonated under pressure Such drinks are nonalcoholic and have *no food value except for their calories* They contain approximately 10% sugar Some carbonated beverages contain caffeine a fact which many do not realize Confusion also exists concerning the fruit flavored drinks which are often believed to be fruit juices Harvey estimated that in 1952 the per capita consumption of soft drinks in the United States averaged 173 bottles In other words our national consumption was 1½ billion bottles

A detailed discussion of **alcoholic beverages** has no place in a book such as this They are food adjuncts however in the broad sense of the term Within limits alcohol may serve as a source of fuel It has a calorie value of 7 calories a gram and in amounts not to exceed 10 c c pure alcohol per hour, it can be oxidized by the body and yield at this level approximately 70 calories which can replace an equal calorie amount of carbohydrate or fat hence it does have a slight sparing action It has no food value other than calories Aside from the emotional psychological and depressant action its ingestion in large quantities may decrease the intake of essential foods a condition which is highly undesirable Its excessive ingestion in addition to an adequate diet leads to obesity When a calculated diet is necessary alcoholic intake cannot be ignored Again the watchword— moderation marks the dividing line between desirability nonharmful and harmful effects

Review Questions

1 What value have vinegar spices herbs and flavorings in the dietary?
2 Are tea and coffee contraindicated in the diet of the adult? What is their value?

3 How do chocolate and cocoa differ from tea and coffee? In what component are they similar?
4 What is the value of soft drinks?
5 Has alcohol any nutritive value?

Suggested Projects

1 Examine your own weekly menus What food adjuncts did you include in your diet? Were they used judiciously?
2 Examine the menus or recipes of a culture pattern different from yours Are food adjuncts similar or dissimilar from yours?

CHAPTER 17

FOOD HAZARDS, FOOD FADS, AND FOOD PROTECTION

Although advances in public health have been striking within the last half century, vigilant watch is necessary to maintain safe food standards. Laws and law enforcement agencies exist today as a protection to the American public. Another factor which governs the eating pattern of our country is food fads and fallacies. In spite of the present knowledge of nutrition, erroneous concepts are prevalent throughout the country. Sound education by reputable authorities seems to be the best method at present to combat the harmful effects of blind acceptance of food fads and fallacies.

In discussing food in relation to health the assumption is naturally made that a normal individual plus adequate diet equals health. However, at times an apparently adequate diet may actually result in ill health and may directly or indirectly cause disease. Because of a food sensitivity or allergy (Chapter 41) ingestion of a food may result in an undesirable reaction of varying degrees of severity. In this instance the individual and not the food is to blame, or the food may act as a vehicle for unfriendly organisms or worm infestations, or the food itself may be infected as in botulism, ptomaines, or in food poisoning. Food may be contaminated during the process of manufacture unless proper sanitary precautions are taken, and the contamination may be human or environmental.

Food Hazards

Typhoid fever in the past more than at present caused grave concern. Today we know it can be contracted only through carelessness in the observance of good sanitation, such as the disposal of human excreta. Carelessness here can result in underground seepage to wells, streams of water, or other water supply and thereby cause spread of the disease. There may be improper supervision of the typhoid carrier, the individual who constantly harbors the typhoid bacillus in his intestinal tract

without active sign of the disease, and who may never have had typhoid fever himself. This has resulted in more than one outbreak. Typhoid carriers should be kept from contact with any food supply. Various types of dysentery may become prevalent in a locality because of water supplies contaminated by human sources.

Tuberculosis, human or bovine, may be contracted from the ingestion of infected food.

In recent years many states have passed sanitation laws governing milk production. These laws require that all milch cows reacting to tuberculin test be destroyed. Pasteurization is rapidly becoming compulsory. This practice and clean herds are becoming effective weapons in the elimination of at least the intestinal form of tuberculosis in man, which is of bovine origin

Undulant fever and septic sore throat may be acquired through milk as the carrier of the disease organisms. Such milk is contaminated by the infected cow or the infection may come directly by contact with the animal itself. Undulant fever with its recurring attacks and debilitating effect is a serious handicap of long duration. Milk may also be contaminated by the careless handler who may bestow typhoid, diphtheria, scarlet fever, or poliomyelitis-causing organisms. Again, the importance of the pasteurization of milk cannot be overemphasized. Even though a herd and handlers are inspected periodically, there exists the possibility of contamination between examinations.

Meats may be infested with tapeworm, and when eaten without proper cooking, infestation of the gastrointestinal tract is probable. Pork is not infrequently infested with a small, round parasitic worm known as trichina which, as it migrates from the intestinal tract into the muscles, gives rise to a grave clinical condition known as trichinosis, in which the reaction is severe and frequently fatal.

The products of bacterial metabolism are another source of food contamination. In this group belongs **botulism.** The organism (*Bacillus botulinus*) under anaerobic conditions (in which no oxygen is present) grows in organic matter and produces a toxin. No change in flavor warns of its presence, although gas formation takes place and may cause bulging of the can of contaminated food This bacillus cannot grow in acid foods, but is

found occasionally in nonacid foods such as canned meats, corn, beans, asparagus, and peas. Unfortunately, while the organism is killed in the canning process, spores (or undeveloped bacilli encased in a shell) may have formed. These are heat resistant and may escape the first cooking. Later they develop and release an active organism which in turn produces more of the toxin. This is why the aforementioned foods, particularly if home canned, should be brought to a brisk boil after the can is opened before the food is even tasted. The reheating destroys any newly formed organisms and their toxic secretion. Botulism fortunately is rare today because of modern vacuum process canning methods. The mortality in botulism is high. The onset of symptoms is from eighteen to thirty six hours after infection and includes either severe gastroenteric or nervous system upsets, or both.

Ergotism is another example in which bacterial metabolism causes a toxin. This disease is caused by ingestion of "spurred" rye, or rye on which the fungus parasite *Claviceps purpurea* has grown. Anesthesia and recurrent convulsions are the symptoms of this disorder.

Food poisoning may occur as the result of the presence of bacilli of the paratyphoid group (one of the intestinal groups). This infection produces diarrhea, vomiting, abdominal pain, and fever in from six to twenty-four hours after partaking of the infected food. Such contamination may occur in any type of food. Summer heat causes bacteria to multiply rapidly, and the need for additional care in the handling of food during this season must be emphasized.

Many cases of food poisoning are in no way traceable to infected food but are caused by some temporary physical or psychic maladjustment on the part of the eater. Only when a group of individuals who have partaken of the same food are similarly affected can one assume that the fault lies in the food eaten.

Many gastrointestinal attacks are erroneously called ptomaine poisoning by the laity. A **ptomaine** is a breakdown product of nitrogenous material (a product of bacterial action). In general, and fortunately, by the time meat has reached the stage where this type of decomposition exists, it is ostensibly unfit for human consumption. The mechanical clinging of bacteria to meat and

the resulting entrance of the bacteria into the gastrointestinal tract, is not ptomaine poisoning in the correct usage of the term

A third group of diseases results from the ingestion of toxic substances, not of bacterial origin, in plants which are not intended for human consumption Poisonous fungi have been mistaken for mushrooms, the root of the water hemlock, or monkshood, has been mistaken for horseradish, and the young shoots of laurel for the wintergreen which they resemble

Shellfish may be rendered unfit for food if taken from contaminated water During the spawning season some fish should not be eaten

Certain alkaloids, poisonous to man develop in foods, for example, the increase in the solanin of potatoes during sprouting

Occasionally accidental poisoning occurs Foods may be roasted or dried in contact with coal gas which contains arsenic *Antimony may be absorbed by foods from cheap enamel lined containers used for storage* This is especially true of food having high tartaric acid content Lead water pipes, tinfoil old fashioned tin cans are all possible sources of lead poisoning Today tin cans are coated with lacquer so that no chemical action can affect the food, and can contents may, therefore be left in the can after opening

Food Fads and Fallacies

Food fads and fallacies are rampant At a time when health efficiency and economy are important, it becomes increasingly necessary to sort these out from the scientifically accepted food facts and discard them forever Clever advertising needs intelligent understanding as a weapon of resistance *Neither food fads nor fallacies have support in scientific fact*

Food fads and fallacies are closely related, in fact, some make no distinction between them A food fad, however, suggests a temporary pattern of high popularity, whereas a food fallacy is usually considered as a belief about foods which is handed down from one generation to another Neither is based upon fact and a fallacy may owe its beginnings to a highly celebrated food fad

Food fads often suggest that one or two foods will be a "cure all" for anything that ails the individual Extravagant promises are made concerning foods *Of course no food is especially a*

health food." Every food contributes to the health of the normal individual. Exception must be made for those who have digestive, absorptive, or metabolic derangement, or who suffer from special food idiosyncracies or food allergy. And for the purpose of human nutrition "every food is pure when no injurious ingredient has been added in the processes of manufacture, storage, or distribution, when no spoilage or deterioration has taken place, and when no element of dietary importance has been removed from the materials produced by nature." No particular food 'builds up resistance,' can 'purify' the blood, 'break up a cold,' or 'cure insomnia.'"

One of the greatest perpetrators of food fads is the pseudo scientist. He is characterized by his interest in selling his particular product. He may describe and discuss various products by referring to reputable research concerned with a problem which he thinks is similar. Often the research is quoted out of context or undue emphasis is given to a specific finding. As the pseudo scientist may use a vocabulary rich in scientific terms (though the mistakes in such usage are not easily detected by the layman) he is able to persuade the gullible to accept the food fads he advocates. Some of his claims may be based on half truths which only serve to make them seem more plausible to the layman. However, it must be kept in mind that the pseudo scientist does not write for ethical professional journals nor does he present papers at conferences or conventions sponsored by reputable scientific organizations.

The fads which may actually be harmful are those which control diet patterns. The vegetarian diet which contains neither milk nor eggs will undoubtedly be deficient in protein of high biological value.

Those who do not combine starches and protein because one digests in alkaline media and one in acid have only to study physiology to know that few foods are pure protein or starch. Foods are mixtures of foodstuffs—and what is more, when protein breaks down in the body it yields practically one half of its weight as carbohydrate (see Chapter 5).

With the increasing emphasis upon obesity, perhaps those desiring weight loss are the most fertile soil for food fads. However, any easy way for rapid weight loss will of necessity involve a diet which is not properly adjusted. Of all diet fads probably

those designed for weight loss are most dangerous (see Chapter 22) For the intelligent person, the subject of "Hollywood diets" can be dismissed with the single word DON'T!

That food fallacies or superstitions were deeply ingrained is evidenced by the answers to a questionnaire sent in 1932, asking parents and teachers of elementary school children in fourteen states if they believed that fish improved the brain Fifty nine per cent of the parents and 32% of the teachers said "yes" Perhaps the knowledge that no one food is specifically a brain food is more general today than then, but the current prevalence of food fads is proof that the American public is still gullible Such an idea probably arose from the fact that there are phospholipids in the brain and that there is phosphorus in fish But so there is in other foods

There are those who believe that water with meals is harmful or that it makes one fat It is true that large quantities of cold water used to wash down mouthfuls of unchewed food are not desirable Water, however, in moderation is advantageous It helps digestion by facilitating the mixing of the gastric juice with food Twenty minutes after drinking ice water, the stomach's temperature is again that of the rest of the body This is the same time interval for it to reach body temperature after drinking a hot beverage Water has no caloric value

Common "table salt" is accused of being responsible for cancer, high and low blood pressure, tuberculosis Bright's disease gray hair, and baldness

Cream, cheese, and butter have been credited with being the cause of deafness and pasteurized milk with bringing about heart lesions in children, fasting has been suggested as a cure for cancer and both milk and aluminum cooking utensils advertised as the causative factor These claims obviously are known to be false by one trained in nutrition, but, unfortunately too few have this information

Physical work is reputed to require extra meat Two generations ago scientists disproved the idea that muscle work demanded protein Carbohydrate is the first source of body fuel

Rich foods are indigestible! How frequently one hears this said Digestibility or indigestibility is a question of completeness of utilization Therefore, fats are very digestible Ease of

digestion is another matter. Fats do delay digestion and fat foods are usually compact and concentrated; hence, they do take longer to digest. This time factor is a matter of no concern to the normally healthy person. It may, however, make it preferable to limit excessive fat for small children and those with impaired digestion.

Red meat is not less wholesome than white. As a general rule, cooked fruit is no more digestible than raw. Most fruits are perfectly digestible in the raw state when ripe. Unripe fruit is not poisonous but it is digested more slowly than the ripe fruit where the carbohydrate (starch) has turned to sugar. Starch requires cooking to be effectively handled by the human body. Bananas are very well handled even by small infants.

Milk and sea food may be eaten in any combination and no difficulty will arise (if the food is unspoiled) unless some allergy or temporary disorder exists in the individual.

Seeds do not cause appendicitis; cheese and milk, even if boiled, are not constipating; clear coffee is not less harmful than when sugar and cream are added; garlic has no therapeutic value, etc. The number of food fallacies in this country are endless. Each community, each family has its own. In the past, many of these fallacies were based on trial and error feeding methods; many were acceptable in the light of the knowledge available at that time. However, today we refer to them as "old wives' tales."

With a wide variety of foods from which to choose, why is there such concern about food fads and fallacies? The following of such practices may have adverse effects upon the individual. If there is a limited amount of money for food, expensive unnecessary items may be purchased. This may result in an unbalanced budget so that there are insufficient funds for necessities other than food. By believing that a certain food or combination of foods will provide all that is needed, in nutrients, the individual may actually be eating an unbalanced diet, a diet lacking in necessary nutrients. An individual who becomes a zealous food faddist develops an unwholesome attitude toward food. He also may have a tendency to believe that he can treat himself *by eating the so called "health" foods if "he doesn't feel well"* instead of securing competent medical attention. It is wise, therefore, to secure information about foods from reputable

PART II

NORMAL NUTRITION

CHAPTER 18

NUTRITIVE NEEDS IN PREGNANCY AND LACTATION

The health of both the mother and the fetus has been shown to be affected by the nutritional status of the mother The mother often enters pregnancy in a state of poor nutrition *Thus she must improve her own* health in order to bear a normal healthy child The diet in pregnancy, which is easily adapted from the basic diet, emphasizes an increase in proteins, vitamins, and minerals Calories are not increased as much proportionately as the other nutrients. Lactation makes even greater demands on the mother

It has been said that the capacity for reproduction is a function of the well being of the animal, and that dietaries which affect the *general well being either adversely or favorably* will affect this function in a like manner In other words, the ability of an animal to reproduce and rear young successfully is a criterion of fitness and vigor In fact, the nutritive value of a ration may be appraised by the number of healthy litters of young which can be raised while the mother feeds upon it

The effect of good *nutrition on fertility* of animals has long been recognized As early as 1921, sows on an A deficient diet were reported to give birth to malformed offspring Later reports describe pigs without eyeballs, with cleft palates, harelips accessory ears, misplaced kidneys, etc In 1940 Warkany and his co workers were able to show that deficiency of *riboflavin* was important They produced abnormalities in one litter, could prevent it in the next, *produce it again at will, indicative* that the diet injured the offspring rather than the mother

Any dietary deficiency, whether it be deficiency of vitamins minerals, protein, or total calories, will have its influence upon *fertility* Vitamin deficiencies operate in various ways, as has

been pointed out under that discussion McLester expresses the idea when he says "reproduction is not the function of the generative organs alone but of the whole organism the well being of the entire animal is of determining influence" One vitamin E is specifically designated as the antisterility vitamin and it is needed for the reproduction of *certain* animals Its specific place in the human being is not proved its effectiveness in preventing repeated abortion having been both confirmed and denied In addition to vitamin E extreme deficiency of vitamins A B C or of essential fatty acids has been shown to result in sterility of animals

One of the several important studies carried out to determine the effect of diet on pregnancy was that by Dr Harry Ebbs from the Department of Pediatrics of the University of Toronto

Briefly a group of pregnant women found to have very poor diets were divided into two groups One group of 120 women on poor diets and with low incomes were followed during the last half of pregnancy as controls for 90 women on equally poor diets and low incomes who were supplied with milk eggs cheese oranges canned tomatoes wheat germ and vitamin D capsules and who were instructed in the type of diet necessary for pregnancy The observations made throughout pregnancy during convalescence and upon the baby showed a striking difference The incidence of miscarriages premature births and stillbirths the number of infections in the mother and her general condition both mental and physical were much better in those who received the extra food Changes in the blood of the mothers given extra food gave evidence that they were in better condition during the stress of pregnancy The general condition of the babies born of mothers who received the extra food was much better than the condition of those born of mothers who were left on their poor diets The incidence of illness among the babies was much greater in the poor diet group

While it is well recognized that there are many factors in the successful outcome of pregnancy it seems reasonable that proper nutrition will insure a more optimum general condition of the mother which will possibly prevent or at least minimize the complications which occur in pregnancy The tired depressed and physically poor women in the Ebbs study (Table 45) with a past history of a high percentage of complications were poor ob

stetrical risks But even in four or five months of proper feeding, this condition was greatly improved and the outcome of pregnancy was not only better than with those who were left on their poor diet, or who ate what was termed a "good diet," but resulted in a lower rate of complications than they had experienced in previous pregnancies.

Other studies on methods of evaluating the nutritional status of mothers and infants have been carried out or are in progress, data are accumulating.



Fig 56 —Photograph of two puppie [illegible] eeks from
weaning on the same diet, deficient ir [illegible] t) was
the offspring of a mother fed during [illegible] t rich
in vitamins A and D and containing [illegible] nother
of puppy 2 (right) was fed on a di [illegible] having
oatmeal as the cereal It will be notec [illegible] ickets
while puppy 2 has developed severe [illegible] H M
Stationery Office from Medical Resea [illegible]

Burke has reported on studies carried out by the Department of Maternal and Child Health of the Harvard School of Public Health in conjunction with the Boston Lying-In Hospital Earlier research dealt with 216 women and their infants Subsequent reports were concerned with 68 younger siblings born to 57 of the original 216 women Extensive dietary histories which gave a picture of the average daily food intake for the latter part of pregnancy were obtained from the women The histories were carefully cross-checked to reduce all errors to a minimum

Burke found the following in the 284 cases "Where the diet was 'good or excellent,' 95% of the infants were in good or ex-

cellent physical condition at birth, in contrast when the maternal diet was 'poor to very poor,' 65% of the infants were in the poorest physical condition at birth (this means that the infants were stillborn or died in the neonatal period were premature or functionally immature or had a marked congenital defect) 27% were in a fair condition at birth and only 8% were

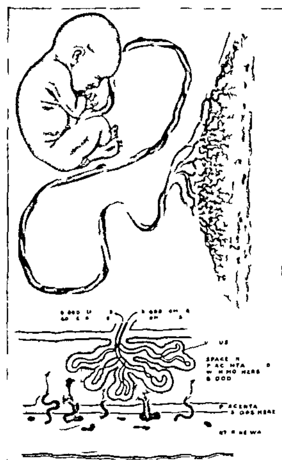


Fig 57.—Diagrams to show the relation of the maternal and fetal circulations (From Bogert Nutrition and Physical Fitness W B Saunders Co)

in good or excellent physical condition She further discussed the differences in birth weights and birth lengths of infants in the three dietary categories

As a concluding thought Burke suggested that "the fetus may suffer far more quickly and with less maternal disturbance than is generally appreciated when the mother is malnourished"

This thought gives an entirely different concept to the mother fetus relationship Many young mothers and mothers to be are of the opinion that the fetus develops normally at the *expense* of the mother Instead, it is suggested that the fetus itself may suffer considerably if the mother is malnourished

TABLE 45

DIET IN RELATION TO COMPLICATIONS IN PREGNANCY

Complications During Pregnancy		
COMPLICATION	POOR DIET	SUPPLEMENTED GOOD DIET
Anemia	28 6%	16 1%
Toxemia	7 6%	3 4%
Threatened miscarriage	8 4%	1 1%
Miscarriage	6 0%	0
Premature birth	8 0%	2 2%
Stillbirth	3 4%	0
Breast abscess	3 0%	1 1%

*Obstetrician's Rating of Patient During Pregnancy**			
		POOR DIET	SUPPLEMENTED GOOD DIET
Prenatal period	Good	64	91
	Poor	36	9
Labor	Good	76	97
	Poor	24	3
Convalescence	Good	88	96
	Poor	12	4
Whole course of pregnancy	Good	66	94
	Poor	34	6

*The obstetrician was unaware of the diet group to which each patient belonged

Thus the logical diet in pregnancy is the normal diet of the mother enriched to permit her to *produce another life without* sacrifice of herself Table 48 includes the recommended allowances of nutrients of the National Research Council This is compared with the allowances recommended for the 25 year old reference woman These allowances are based on the assumption that the mother comes to pregnancy in a good nutritional state *If she is malnourished, or suffering from a* conditioned nutritional deficiency, it should be corrected during the first half of pregnancy before the fetus makes excessive nutritional demands

Table 49 includes a basic menu pattern for pregnancy and lactation The basic diet for a 25 year old woman is used as the foundation (see Table 74), and modifications are made to meet

the recommendations of the National Research Council This diet is lower in calories than the recommended allowances The difference in calories however can easily be met by the addition of *extra portions of the foods listed in the diet or those foods* that are of concentrated caloric value

During the first half of pregnancy there is no increase in metabolic rate and no calorie increase is necessary in fact it is undesirable if the woman s weight is essentially normal After the fourth month more rapid fetal development calls for an increased calorie intake until just before delivery when there is 20% metabolic increase and an approximate weight increase of 15 to 20 pounds

The diet of the pregnant woman should contain adequate amounts of protein of high biological value milk eggs and meat Especially important is the calcium phosphorus and iron intake In regard to the vitamins as we have already said a deficiency of any one of them is highly undesirable At this time supplementation of the normal diet by cod liver oil or some other source of vitamin D is necessary if normal structural development is to take place

While during pregnancy it is important that the diet shall be adequate and the health of the prospective mother optimum it must be remembered that health habits of rest exercise bathing serenity of spirit are all factors which may play important roles

At no other time in life is the daily quart of milk so necessary as when the mother is carrying her child The calcium need is increased at this time and 1 5 to 2 gm daily is the preferable intake This cannot be accomplished without the inclusion as a minimum of the quart of milk In addition it will be remembered milk will contribute phosphorus and vitamins A B B_2 and protein and this quart will help protect against deficiencies of these vitamins By including cream soups custards cocoa etc it will not be difficult to consume this amount

The daily inclusion of meat or fish increases the level of intake of protein to the daily optimum of 85 to 100 gm Diets in pregnancy are no longer restricted in protein to reduce kidney work There is no sound basis for such restriction except in certain toxemias which occasionally develop Such complications as the toxemias are outside the scope of this discussion of normal pregnancy Protein restriction is harmful in normal pregnancy The

inclusion of fish once or twice a week increases the iodine intake, *which is desirable (see discussion of Iodine in Chapters 10 and 13), because, with the added strain of pregnancy, thyroid abnormalities may develop.* Liver contains many dietary essentials and is effective in preventing the development of anemia, often a complicating condition in pregnancy. *One or two eggs a day* add phosphorus, sulfur, some iodine, lecithin, vitamins A, B, and D, iron, essential fatty acids, and fat in a finely emulsified form which is readily digestible.

If not contraindicated, the whole grain cereals should be used in preference to the highly milled ones. The tendency toward constipation (due to pressure of the enlarging uterus on the intestines) may be corrected by cereal roughage, and good use is made of the vitamin and mineral content of the whole grain products *For the same reason, liberal amounts of green, leafy* vegetables and fruits should be consumed each day. Two servings of each should be routine procedure.

A plentiful amount of liquid, especially water, will facilitate the work of the kidneys in eliminating certain metabolic end products and should be the practice unless definitely contraindicated.

The disturbances manifested by nausea and vomiting in the early months of pregnancy result, according to one theory, from the incomplete establishment of the connection between the embryo and the mother. These disturbances are not due to disagreement of food or to digestive upset. *Usually increased intake of carbohydrate and decreased intake of fat, and smaller and more frequent meals* with a light breakfast before rising, will result in greater comfort Pyridoxine in doses of 10 to 50 mg. has been used with some success in the control of nausea If the vomiting persists ("pernicious vomiting"), medical advice should be sought.

The craving for certain foods during pregnancy should be satisfied only after basic essentials have been supplied. When the basic needs have been met, the dictates of appetite may be followed as desired, with precaution against unwanted weight change. These cravings, or chance unpleasant sights or thoughts, it must be remembered, have no effect upon the developing fetus, superstition as to "markings" of old wives' tales to the con-

tiary If it had, few children would be born physically perfect There is no nerve connection between mother and child, but only an exchange of soluble materials through the placenta and umbilical cord These two structures develop during pregnancy to supply structural material and oxygen to the fetus and for the removal of waste

About the third month of pregnancy the development of the fetus is complete, and it lies inside a closed membrane, completely filling the inside of the uterus Here, as an aquatic animal, the child lives in a world all its own, shielded and protected to the utmost degree, until delivery

Complications in Pregnancy

Pregnancy is a normal, physiological function and under most circumstances proceeds to term without complications When abnormal conditions arise however special treatment must be instituted dietetically and medically

"Morning sickness' (a mild toxemia) appears in about 50% of all pregnancies In the usual type of vomiting little alteration in diet composition is necessary as breakfast high in carbohydrate and eaten in bed will usually offset the condition However if it persists throughout the day high carbohydrate meals, smaller in amount and eaten at more frequent intervals, may help to control the vomiting If the vomiting becomes pernicious food by mouth is withheld for twenty four to forty eight hours, and infusions of normal saline and of 5 to 10% glucose are given The total volume required will depend upon the degree of dehydration of the patient usually 2 500 c c or more If a ketosis is present, insulin and glucose are sometimes given As food tolerance returns the patient should be permitted to eat what she desires, rather than to force a planned diet upon her After the acute period has passed the diet can be readjusted In the meantime, commercial vitamins and minerals may be used to prevent deficiencies

Eclampsia (convulsive seizure during pregnancy) in mild or severe form may be a complication of pregnancy Dietary control is a matter of debate Some authorities contend that protein should be sharply curtailed, others say that it should be increased, and still others maintain that it should be left at normal

tain how closely his intake approaches his requirement With no change in clothing, the difference in weight of a baby before and at the completion of nursing is a measure of the food ingested Other criteria of adequacy are satisfactory weight gain, happiness of the baby, and his sleeping habits between feedings

The normal infant weighs 6 to 7 pounds at birth doubles his weight in five to six months, and triples it by the end of the first year There should be steady weight gain of about 4 to 8 ounces weekly, 6 to 8 ounces in the first six months, and 4 to 6 ounces in the second six months If the mother's milk could be produced with perfect efficiency, there would be immediate need at parturition (if the child weighed 7 pounds) for approximately 350 extra calories daily in her diet, as can be seen by the calculation 7 pounds × 2½ ounces of milk per pound × caloric value of 20 calories per ounce of milk

TABLE 47

ASH CONSTITUENTS OF HUMAN MILK

	PER CENT
Calcium phosphate	23 87
Calcium sulfate	2 25
Calcium carbonate	2 85
Calcium silicate	1 27
Potassium carbonate	23 47
Potassium chloride	12 05
Potassium sulfate	8 33
Magnesium carbonate	3 77
Sodium chloride	21 77
Ferric oxide and aluminum	0 37
	100 00

Considering the normal weight gain, it is found that during the first month the daily requirement of the infant will be roughly 500 calories daily, during the second month 600 calories during the third 700, and so on (see Chapter 21) The food requirement of an infant is roughly three times as great per unit of body weight as that of an adult

The production of milk is not accomplished with efficiency There is dissipation of energy and food value in the transfer of food material from the mother's diet to her milk Therefore, more is involved than simply meeting the baby's requirement Experimentally, it has been shown that only 50% of the food

protein is converted into milk protein consequently for every gram of milk protein the mother s diet must contain 2 gm of food protein The protein value of human milk is variously given from 1 2 to 2%—an average of 1 6% protein or 0 45 gm protein per ounce × 17 5 ounces of milk (7 lb × 2½ oz) = 7 88 gm of milk protein To obtain this extra 8 gm of milk protein 16 gm of food protein must be eaten

The precursors of the other constituents of milk are found in the mother s blood as the end products of her digestive processes There is evidence of a vitamin loss between the mother s blood and her milk especially loss of the vitamin B complex An increase in vitamin B complex is therefore recommended for the mother s diet Vitamin C of the milk is dependent upon its content in the diet Unpublished data obtained by one of us indicate that the ingestion of fruit between one and two hours before the nursing period rather than at mealtime assures an increased level of vitamin C in the breast milk at nursing time Only by a more than adequate intake of vitamin C by the mother can the baby be assured of his share From a 50% increase to a doubled intake is suggested Unless the child is receiving a fish liver oil the mother s diet should contain such a supplement to assure optimum bone development in the child It also has a protective value to the mother herself inasmuch as some of the vitamins A and D of her food are diverted from her body use to the milk she produces

To summarize the diet during lactation must have a caloric intake up to 50% greater than the diet at the end of pregnancy (One calorie as milk requires approximately two calories of food) It must also have higher protein level especially of foods having high sulfur content increased calcium phosphorus and iron and an increased vitamin intake These requirements will be met if the diet contains basically each day one to one and one half quarts of milk a generous serving of meat or fish (liver twice a week one or two eggs cheese a glass of orange or grapefruit juice (200 c c either fresh frozen or canned or the pulp equivalent) two vegetables other than potato a second fruit a generous serving of butter or fortified margarine and a cereal and cereal product both prepared from whole grain or a cereal reinforced with wheat germ or one of the enriched "

TABLE 48

RECOMMENDED DAILY ALLOWANCES FOR 25 YEAR OLD REFERENCE WOMAN, PREGNANCY AND LACTATION

(Food and Nutrition Board, National Research Council, Revised 1953)

	WEIGHT KG (LB)	HEIGHT CM (IN)	CALORIES	PROTEIN GM	CALCIUM GM	IRON MG	VITAMIN A I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG	VITAMIN D I U
Woman, 25 year old	55 (121)	157 (62)	2,300	55	0.8	12	5,000	1.2	1.4	12	70	---
Pregnant (3rd trimester)			Add 400	80	1.5	15	6,000	1.5	2.0	15	100	400
Lactating (850 ml daily)			Add 1,000	100	2.0	15	8,000	1.5	2.5	15	150	400

See Table 3 for explanatory footnotes

flours or cereals. As a dietary factor, not as medication, the inclusion of a fish liver preparation is a wise precaution.

The increased need during lactation is indicated by comparing the values recommended by the Food and Nutrition Board (Table 48).

Lactation may be influenced by factors in addition to the basic biological limitation and adherence to a dietary regime of higher caloric, protein, and vitamin intake.

Adherence to this dietary should bring favorable results, but it must be remembered that psychic influences have tremendous force. Freedom from worry, sufficient rest, happiness, general relaxation, and good health habits are essential.

Breast feeding should be continued if possible at least until after the sixth month and may be continued until the seventh or eighth month. The exact time will depend upon a number of factors: the milk supply, health of the mother and child, and environmental conditions. Weaning is preferably done gradually, over a month's period.

When the "mixed" feeding is being carried out, the amount of food received from the breast must be determined in order to calculate the amount of supplement necessary for adequate feeding.

TABLE 49

ADJUSTMENT OF BASIC DIET (TABLE 74) FOR NUTRITIONAL NEEDS OF PREGNANCY

FOOD	BASIC DIET	PREGNANCY (LAST TRIMESTER)	LACTATION
Milk, whole	2 cups	4½ cups	6½ cups
Egg	1	1	1
Meat, poultry, fish	4 ounces edible portion	6 ounces edible portion	6 ounces edible portion
Bread and cereal, whole grain or enriched	4 slices	6 slices	6 slices
Potato, cooked	1 small	1 small	1 small
Vegetable, green leafy or yellow	½ cup	½ cup	½ cup
Vegetable, other	2½ cups	2½ cups	2½ cups
Fruit, citrus	4 fl. oz. or 1 serving	4 fl. oz. or 1 serving	8 fl. oz. or 2 servings
Fruit, other	2 servings	2 servings	2 servings
Butter or fortified margarine, oils	3 tablespoons	3 tablespoons	3 tablespoons

These diets do not meet the recommended dietary allowances for calories. Calories may be obtained easily from additional amounts of foods listed above or other foods such as desserts, cream, or concentrated sweets.

Review Questions

1 To what food nutrients should special attention be paid during pregnancy?
2 Which of these nutrients have been found lacking in the diets of young people today?
3 What are the assumptions upon which a diet during pregnancy are based?
4 What is the modern theory in regard to protein intake during pregnancy and its possible connection with eclampsia?
5 Is there need for calorie increase in the diet of the mother during lactation?
6 Is there need for calorie increase in the diet of the mother during pregnancy? If so, what causes this increase?
7 Should the amount of any of the food nutrients be increased during *lactation? If so, which ones?*
8 Are there any other factors which may influence milk production?
9 When should the preparation for lactation begin?
10 What are some of the complications of pregnancy and how may they affect the diet of the mother?

Suggested Projects

1 *Adjust your own menus in terms of the suggested menu pattern in* Table 49 for a diet in pregnancy Do you have difficulty in including all the necessary foods in your daily menus? What are some of the ways you adjusted your menus? What is the total caloric value of your menus if you were to include the "extras" you like and the foods in Table 49? Would your weight be affected?
2 Interview someone you know who is pregnant Evaluate her menus in terms of the information you have learned List the problems she may indicate that she has in including necessary foods in her menus
3 Interview a physician Ask him (or her) about the supplementary vitamins and minerals he prescribes for his patients who are pregnant. Are these in addition to foods which will supply the amounts recommended by the National Research Council?

CHAPTER 19

THE FEEDING OF INFANTS

The nutritive needs of the infant are the same whether he is breast fed or formula fed. A guide for calculating the formula on an individual basis is discussed. The need for modifications of that formula and alternate forms of milk are described in detail. Foods are added to the infant's diet during the first year. Possible methods of serving these foods are suggested. The environmental aspects of feeding which are also important are described. Fitting the feeding of the infant into the daily routine of the mother so that it is a natural process whether it be formula or breast feeding is important in infant feeding.

Breast feeding of infants is the preferred method during the first six months. Rarely is there a child who cannot tolerate his mother's milk. With a cooperatively planned program by the physician and mother, it has been estimated that at least 85% of women can nurse their babies for at least a few months.

Gurlee in his 1935 Chicago study found that in a series of 9,449 babies 48.5% were breast fed and in this group the mortality was 1.1 per thousand. In the group where there was mixed breast and bottle feeding the mortality was 5 times as high, and in the completely bottle fed it was 10 times as high. Of course one must recognize the factor of intelligence and sanitation in the figures for bottle fed babies.

Breast feeding has the advantages of requiring no modification of the milk, it obviates the danger of contamination and it is less effort for the mother. It does interfere with the mother's free time and where this is a hardship to the point that breast feeding might be discontinued, the use of one bottle feeding a day may be adopted. In inability to produce milk, active tuberculosis or other disease condition, artificial feeding must be used. During infancy, whether the feeding be artificial or natural, the schedule outlined later in this chapter should be observed.

As has been pointed out in the preceding chapter in the section on Lactation, the approximate food requirement for any

fant can be calculated The amount must be sufficient to permit a steady weight gain of from 4 to 8 ounces weekly after the first initial loss in weight has occurred A slow steady gain is *desirable The best criterion of proper feeding is this steady* weight gain coupled with a happy baby (one who is not restless or irritable) whose recovery from minor ailments is rapid and who has bouts of neither diarrhea nor constipation

Complicated formulas have been used in the past when breast feeding was impractical Today, greatly simplified formulas feed the child as adequately

As in the planning of diets for the adult certain requirements must be met The approximate caloric need is of first consideration and for the normal growing infant is indicated below

Murlin * in discussing the normal processes of energy metabolism emphasizes the multiplicity of factors concerned in building up the energy requirement of an infant (Table 50)

TABLE 50

Basal metabolism	60 calories per kilogram
Activity metabolism (12 40% of basal)	7 2 24 0 calories per kilogram
Loss by feces (10 15% of basal)	6 0 9 0 calories per kilogram
Dynamic action (*10 20% of basal*)	6 0 12 0 calories per kilogram
Growth (10 20% of basal)	6 0 12 0 calories per kilogram

* Murlin Endocrinology and Metabolism D Appleton Century Co

At the White House Conference on Child Nutrition in 1932 the total caloric intake of normal growing infants of different ages was averaged from findings in the literature in terms of need for twenty four hours as indicated in Table 51

The **caloric requirement** is roughly 2½ to 3 times that of the adult on a weight basis This obviously is due to the extremely high growth rate The child on the average doubles his birth weight in 5 months and triples it by the end of the first year during which time he has grown 8 to 10 inches in height

In the first weeks of life *the need is 120 to 100* calories per kilo per 24 hours at 6 months 110 to 100 at 1 year 100 to 85 etc Assuming a baby of average birth weight of around 3 4 kilo (7½ pounds) and assuming normal development and need the total rough caloric requirement for a 24 hour period will be that shown *in Table 51*

TABLE 51

AGE	CALORIES
1 month	500
2 months	600
4 months	700
6 months	800
9 months	900
1 year	1,000
2 years	1,200

It must be remembered that *children differ.* They cannot be fed from a set pattern Intelligent interpretation of specific needs is one of the secrets of successful feeding

The second consideration is the **protein level** The protein requirement is directly proportional to the growth rate (See Table 52)

TABLE 52

RECOMMENDED DAILY ALLOWANCES FOR PROTEIN, EXPANDED FOR THE GROWING PERIOD

SUBJECT	AGE	PROTEIN IN GRAMS* TOTAL 1	PER KG 2	PER LB 3	% OF DIETARY CALORIES AVERAGE
Premature†	1 week to 1 month	4 3 per Kg	6 0 4 4	2 7 2 0	17
Premature‡	1 week to 1 month		5 0 4 4	2 3 2 0	15
Premature	1 to 3 months		4 4 3 3	2 0 1 5	13
Full term	2 days to 3 months		4 4 3 3	2 0 1 5	13
All infants	4 months to 1 year		4 0 3 0	1 8 1 4	13
Toddlers	1 through 3 years	40	(4 2 2 9)	(1 9 1 3)	(13)
Preschool	4 through 6 years	50	(3 3 2 5)	(1 5 1 1)	(13)
School	7 through 9 years	60	(2 6 2 1)	(1 2 1 0)	(12)
School	10 through 12 years	70	(2 2 1 8)	(1 0 0 8)	(11)
Youths, female	13 through 15 years	80	(1 8 1 5)	(0 8 0 7)	(11)
Youths male	13 through 15 years	85	(2 0 1 7)	(0 9 0 8)	(11)
Youths female	16 through 20 years	75	(1 6 1 4)	(0 7 0 6)	(13)
Youths, male	16 through 20 years	100	(2 1 1 7)	(1 0 0 8)	(11)

* [illegible] utrition [illegible] ures in [illegible] nces in [illegible] e basis [illegible] Wood [illegible] ces)

‡Premature infants weighing [illegible]000 grams and over

Examination of the **composition of human and cow's milk** (Table 46) indicates roughly a double amount of protein in cow's milk In the past modification included dilution of cow's milk to half value in order to bring this component down to a comparable protein level This is no longer the practice The

two proteins are different in structure Proteins of milk are of two kinds lactalbumin (whey protein) and casein or curd protein Lactalbumin has been thought to have greater nutritive value, probably due to its high cystine (a sulfur containing amino acid) content The protein of human milk is roughly 60% lactalbumin, cow's milk but 15% Whether or not this is the complete answer is not clear, however, the fact remains that infants fed a higher level of protein in the form of cow's milk do better than those whose protein percentage is that of human milk (Recently, experimental work has been reported suggesting the two milk proteins are of equal value for maintenance of the normal adult This needs confirmation and extension into other types of use) The customary level of 2 to 2 5 gm of protein in the form of human milk and 3 5 to 4 5 gm when fed as cow's milk is satisfactory (or, roughly, twice as much when protein is from bovine sources) The figure, 4 gm protein per kilogram, is easy to remember This is the amount of protein supplied by ½ cup of milk (32 gm per quart is approximate value) The value of 4 gm of protein per kilogram represents not far from the 10 to 15% of the total caloric level suggested for adults

> 3 4 kilo baby × 4 gm protein per kilo = 13 6 gm protein
> 3 4 kilo × 120 calories per kilo = 408 calories
> 13 6 gm protein × 4 calories per gm = 54 protein calories or 13% of the caloric need

The foregoing, Table 52, taken from Levine's discussion of "Protein in Pediatrics,"* tabulates the range of protein allowances at different age levels The range is from 11% in the teen ager to 17% for the premature infant

The fat in the diet of the infant supplies from 30 to 40% of the caloric need Were it not for this concentration, the child's caloric need would have to be met by too great bulk When intolerance to fat exists the level may be reduced to 20%, but unless absolutely necessary a level below this is borderline for adequacy of fat soluble vitamins and essential fatty acids The fat level of milk from a mixed herd is approximately 3 5% Such milk is preferable to that of higher fat content (Jersey, Guern

*J A. M A. 128: 283 1945

sey) On a weight basis this is calculated to be approximately the same as protein—4 gm fat per kilogram of body weight

The fat of human milk is in the form of finer globules than that of cow s milk Homogenization evaporation and drying accomplish the same effect hence such milks are somewhat more easily digested

The **carbohydrate** caloric proportion is approximately 50% of the total Milk alone with its carbohydrate content at a 5% level would not be sufficiently high calorically to yield this percentage of calories Since human milk has 2% more carbohydrate than cow s milk it is logical to supplement by this means Usually 3 to 5% carbohydrate is added making the formula milk 8 to 10% sugar The type of sugar added is a matter of preference

There is much discussion as to which sugar is best in infant feeding As an editorial in the *Journal of the American Medical Association*† once stated *'The 'styles' in nutrition to which children are subjected in the earliest periods of life have changed from year to year sometimes in almost a bizarre manner''* Lactose sucrose maltose dextrose and dextrose maltose have all been recommended from time to time by means of skillful advertising The question of digestibility and absorption as well as the caloric value and the cost must be taken into consideration in making a choice The chemical structure may be of importance metabolically For instance dextrose is blood sugar while galactose is a component of the fat constituent of nervous tissue (see Chapters 3 and 4) It is conceivable that sugars which require breakdown before utilization and are therefore slower of absorption may produce diarrhea On the other hand this slower absorption might facilitate better deposition of glycogen, or other factors of physiological use These arguments are used for and against the several sugars Unfortunately prior to the twentieth century when lactose was in general use digestive upsets were attributed to it and several clinical experiments were conducted which were interpreted to prove that lactose was toxic Today we know that it is not and that up to 17% lactose can be used with entire success in the infant formula Lactose would not be the natural sugar of milk if it were harmful to the young of any species Nature would hardly make such a mistake

†J A M A 96 ? 1931

But some prejudice against lactose still exists today Digestive upsets and failure to obtain response on a formula should not be attributed to the one factor of the sugar padding The apparent disadvantages in the past were probably due to lack of proper sanitation and pasteurization Other ingredients or actual infection, either within or without the gastrointestinal tract, must be considered

There is difference in the density of sugars and the volume for a given weight varies (Table 53)

TABLE 53

1 ounce of cane sugar equals 2 level tablespoonfuls
1 ounce of corn syrup equals 2 level tablespoonfuls
1 ounce of lactose equals 3 level tablespoonfuls
1 ounce of Dextri Maltose equals 4 level tablespoonfuls
1 ounce of these sugars equals 120 calories (4 cal/gm)

The popular choice of sugar today is corn syrup, and the usual addition of corn syrup is roughly 5% Karo corn syrup is a mixture of sugars Its composition is 50% dextrin, 23 2% maltose, 16 0% dextrose, 6 0% sucrose, and 4 0% invert sugar It is economical, easily handled, and well tolerated

Dark cane molasses, with its appreciable iron content, yields good amounts of vitamin B_6, some pantothenic acid, and some vitamin B_2, and should prove a satisfactory vegetable sugar It is the crude sugar of the sugar cane The green label brand of Br'er Rabbit Molasses contains 1 mg of available iron per tablespoonful Brown sugar and molasses are mildly laxative and, as such, may be of value

A simple and satisfactory **starting formula calculation** is one in which fluid whole milk (or properly diluted evaporated or dried milk) is fed at 14% of the baby's body weight and with sugar added at approximately a 5% level (See Table 54)

Should this formula not prove satisfactory, adjustments can easily be made

One tall can of evaporated milk (13½ oz) diluted with an equal amount of water may be considered roughly equal to one quart of fluid milk as is one cup of powdered milk made up to a one quart volume with water

The preparation of the formula in the manner suggested above assures the child of an adequate **water intake** Water is

very important in the diet of a child It should be supplied in amounts equal to 10 to 15% of the child's weight (varying of course with weather, which influences loss) The 3.4 kilogram, or 3 400 gram (7½ pound), child will have a need of from 340 to 510 c c water daily The fluid level of 476 cc is sufficient

Dehydration is always a serious condition but especially so in *the infant* *The onset may be insidious the ultimate effect* dramatic and tragic Water is an integral part of every body cell None can continue to function normally in the presence of inadequate water The infant has been an aquatic animal before birth He is especially prone to depletion When a formula is prepared without the use of fluid milk—from evaporated or dried milk—the amount of water added in its preparation should be such that the child's water need is covered

TABLE 54

FORMULA CALCULATION DATA

14% of 3 400 gm (3.4 kg) = 476 c c milk
milk has caloric value of approximately
0.7 calories per c c 476 × 0.7 = 333 calories from milk

The infant's need is 3.4 kg × 120 cal per kg
3.4 × 120 = 408 calories
408 − 333 = 75 calorie deficiency

5% of 476 c c = 23.8 or 24 gm sugar
24 gm × 4 calories per gm = 96 calories from sugar
333 + 96 = 429 calories a leeway of 21 calories
(4% sugar would have yielded 76 calories

That this is a good starting point can be shown by determinations of the calorie ratio

476 c c milk at 3.5% average protein yield = 16.66 or 17 gm of protein
17 gm ÷ 3.4 kg = 5 gm protein per kg

17 gm × 4 cal per gm = 68 protein calories
68 calories is *approximately* 15% of 430 calories

Similar calculation indicates yield to be

18 gm fat—approximately 5½ gm per kg —40% of calories
48 gm carbohydrate—approximately 14 gm per kg —45% of calories

This formula satisfies the water need—water at 10 to 15% of body weight

10% of 3.4 = 340 c c water
15% of 3.4 = 510 c c water

The fluid level of 476 is sufficient

The composition of this formula is readily adjusted by additional water, altering the sugar level, removing some of the cream from the milk, adding powdered milk, or, in rare cases the addition of cream

In calculating the formula it is important that the *optimum weight* of the infant be used rather than the actual weight if this is low The nutritive needs of the underweight infant are as great as those of the normal—he has the same organic muscle mass, only adipose tissue is lacking Mild inadequacy results in slow growth and development, irritability, decrease in resistance to infection, specific deficiency conditions, anemia, and so forth

Prolonged **undernutrition** is a serious matter The caloric outgo is greater than the intake and body tissue is drawn upon The carbohydrate stores are first utilized, then fat stores are drawn upon When fat is burned to a point representing 60% of the total calories, the ability to oxidize it is reached and ketosis results

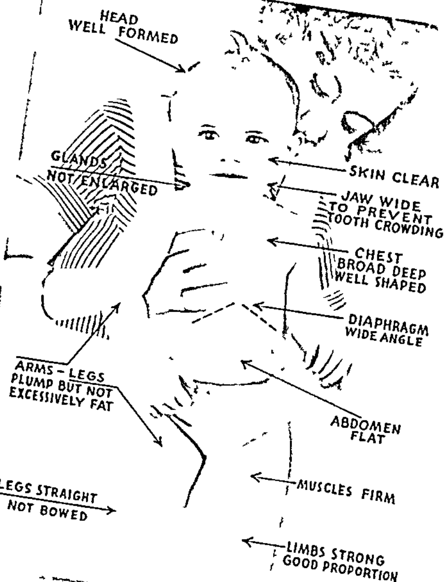
When the subcutaneous fat is gone, the infant becomes emaciated and the protein of muscle, blood, and other organs is drawn upon The blood protein falls, the blood volume is decreased circulation is impaired, and all organs are affected The temperature falls, edema results, the heart becomes weak, and the infant may go into shock Diarrhea and vomiting are not infrequent

TABLE 55

STRONG MEMORIAL HOSPITAL SCHEDULE

AGE	MILK OZ	CORN SYRUP TBS	CALORIES
Under 1 mo	15	1½ (or ¾ oz)	390
1 mo	18	2	600
2 mo	22	2¼	710
3 mo	26	2½	860
4 mo	28	3	920
5 mo	29	3	940
6 mo	30	2	840
7 mo	31	1	740
8 mo	32	0	640
9 mo	32	0	640
10 mo	32	0	640
11 mo	32	0	640
12 mo	32	0	640

Whole pasteurized milk is 14 to 12% of body weight plus 5% of corn syrup Sugar is decreased around the sixth month



Th... ...by ... Fruit ... Exchange)

Starvation is extreme undernutrition

The requirements of undernourished children are higher than those of the normal; an allowance for complete recovery must be included.

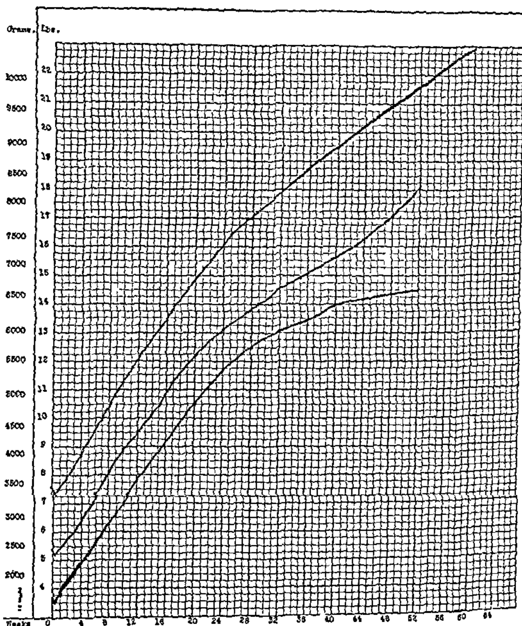


Fig 59 — Average weight curves of infants during the first year of life. (After Camerer from Marriott Infant Nutrition)

As the child grows older, milk, while greater in actual volume, is less in relation to the child's weight The amount of sugar

decreases as other foods add their calories to the total. See Tables 54 and 55.

If the vitamin and mineral constituents of a pint of milk are checked against the child's needs, it will be seen that the suggested basic formula is adequate except for vitamins D and C and for iron. A fish oil and orange juice or a commercial source of vitamin C are introduced into the child's diet in today's practice before the child leaves the hospital. As for the iron, nature has provided for the low iron level of milk. As was pointed out under the discussion of iron and pregnancy, iron is stored in the liver of the fetus in sufficient quantities to carry the child (or any other mammal) through the normal nursing period.

When evaporated milk is used, it must be remembered that it is essentially double strength due to water removal: 7% protein, 7.9% fat, and 10% carbohydrate. Water must be added as diluent.

Special products, of which Lactum is *but one*, may also be used. This is an evaporated whole milk Dextri Maltose formula adjusted to the needs of a full term infant. The caloric ratio is 16% protein, 34% fat, and 50% carbohydrate. In usage some physicians prefer to start with a 1:2 (milk:water) dilution for the first week, with a shift over to the standard 1:1 dilution thereafter.

If cost is not a factor, one of the prepared foods, such as Similac or another similar product of which there are many, may be used. Similac is a modified milk product especially prepared for infant feeding, made by homogenization of tuberculin tested cow's milk (casein modified) from which part of the butter fat has been removed and to which has been added lactose, coconut oil, corn oil, olive oil, cocoa butter, fish liver oil concentrate, ascorbic acid, and thiamine.

Diluted with an equal amount of water the composition is:

Fat	3.4%
Carbohydrate	6.55%
Protein	1.72%
Minerals	0.38%
Moisture	87.95%
Calcium	0.07%
Phosphorus	0.05%
20 calories per oz	

One quart so diluted contains

Vitamin A	2,500 U S P
Vitamin D	400 U S P
Thiamine	0 25 mg
Riboflavin	*0 96* mg
Ascorbic acid	50 mg

The 16 oz (pint) can may be used with any volume of water desired Such a product reduces formula preparation work to a minimum, supplies the need for cod liver oil in early months and is protective against iron deficiency From this standpoint the cost, approximately three times that of a similar can of plain evaporated milk, is not as great as it seems Such formulas, it must be remembered, *usually* require supplementation with vitamin C

The use of acid milk, protein milk, and of milk substitutes may be necessary *The acid and protein milks are sometimes* used in digestive disturbances, and the milk substitutes are used in allergy The acid milks are usually partly defatted or *skimmed milks which have been acidified by lactic acid, citric* acid, orange juice, or lemon juice The addition of the acid produces a finer and therefore a more digestible curd To a thoroughly *chilled* formula, *85%* lactic acid may *be slowly* added with constant stirring in the proportion of 4 c c to 1 quart This results in a fine suspension of curd which does not settle out on standing Too much acid, too warm milk, or too rapid addition of the acid, results in separation of the curd and whey If great excess of acid is added, the curd is redissolved Orange juice in the amount of 2 oz to 1 quart of milk will produce practically the same fine curd

Protein milk is milk enriched with protein It can be obtained commercially or it can be prepared at home by adding curd to whole partly defatted or skim liquid milk The curd may be prepared by coagulating whole milk with commercial rennin (1 quart of milk at 100° F to which is added a Junket tablet) The curd is collected and drained through cheesecloth and then rubbed through a fine strainer into lactic acid milk (1 pint) It is then strained again, and the volume is made up to 1 quart with boiled water A higher protein level may be obtained by

the addition of Casec (calcium caseinate) or powdered skim milk Milk may be reinforced with powdered milk to a double or triple protein content

Occasionally a baby will show sensitivity to cow's milk and substitution is necessary Sometimes such a child will tolerate evaporated milk or hypoallergic milks which have had their protein structure altered by heating If neither of these suffices soybean milk is probably the most satisfactory substitution Commercial soybean products such as Sobee are available or the milk may be prepared from the soybeans at lesser cost The protein of the soybean (glycinin) is of high biological value in contrast to most vegetable proteins The soybean milk is prepared by adding to the soybean meal more than enough water to saturate it This is allowed to stand for two hours and then five times the volume of boiling water is added and the mixture is boiled for ten minutes with constant stirring It is then filtered through a fine cloth The fluid obtained looks not unlike cow's milk and has a composition of approximately 4% protein 1.8% fat and less than 1% carbohydrate The addition of 2% vegetable oil (such as Wesson or olive oil) and 5% carbohydrate (lactose glucose or cane sugar) makes this a satisfactory milk substitute

The formula of Sobee powder is

Soybean flour	61%
Olive oil	19%
Arrow root starch	9%
Dextri Maltose	6%
Dicalcium phosphate	4%
Sodium chloride	1%

By dilution it becomes 2.8% fat 4.2% protein 4.1% carbohydrate and 1% salt

Mull Soy another soybean preparation (an evaporated liquid) has a composition of

Soybean flour
Soybean oil
Dextrose
Sucrose
Calcium phosphate
Sodium chloride
Calcium carbonate

When diluted according to directions, it yields

Protein	3.0 %
Fat	3.9 %
Carbohydrate	4.4 %
Ash	1.0 %
Calcium CaO	0.18%
Phosphorus pentoxide	0.25%
Water—20 cal per ounce	87.7 %

The actual preparation of the formula is important. If pasteurized milk is used, the milk is poured from the bottle (after careful outside cleansing) into a pan and brought to boiling with constant stirring, and held for three to four minutes at boiling point. *It is then cooled quickly and the scum removed.* It is diluted at this point with cool boiled water, if dilution is necessary, sugar having been added to the water. After thorough mixing, the formula is poured into clean, sterile bottles in correct amounts for single feedings, sealed, and stored in a cold place until just before feeding time, when a bottle is removed and warmed to body temperature.

If evaporated milk is used, it need not be brought to boiling as evaporated milk is already sterile. The sweetened, sterile water is added to the milk as it comes from the can, and stored in bottles, as above.

If dried milk is used (Klim), 1 part of the powdered milk to 4 parts of sterile, sweetened water is mixed and stored. It has the advantage of supplying adequate calories at any liquid level.

Directions for acidification or protein reinforcement have been given earlier in this chapter.

Bottles and nipples should always be washed thoroughly, immediately after each feeding.

More recently, *terminal sterilization* of the formula has gained in popularity. *Details for this method will be found in the Appendix.*

The lives of many premature infants are saved today by the care they receive. When hospitalized they are isolated in air conditioned rooms maintained at constant *temperature, and are* fed with great care. In most instances the baby is too weak to take the breast or the bottle, and a medicine dropper or other type of feeder, is used. Breast milk from the child's mother, or from another source, is usually available. *It is now possible*

to buy frozen breast milk. If it is not available a modified milk is prepared. Usually only water is given during the first twenty-four hours. Thereafter, at two- to three-hour intervals, dilute milk is fed, a dilution up to 1 part milk and 3 parts water the first few days as tolerated, with increasing percentage of milk up to the usual formula, or a 5% glucose solution may precede any milk for the second 24 hour period. At the end of this time milk may be gradually added to the glucose. Acidified milks are also frequently used for "the premature" as are dried milk formulas which have the advantage of high nutritive value and low bulk by simple decrease in dilution. The recent use of pureed meat has proved useful as a formula addition.

Levine* has suggested formulas for feeding the premature baby (Table 56). They serve as well to demonstrate range and possibilities for formula prescriptions.

TABLE 56

FORMULAS FOR FEEDING PREMATURE INFANTS PER KILOGRAM OF BODY WEIGHT AND IN PERCENTAGES OF DIETARY CALORIES

MILK		SUGAR	WATER	PROTEIN		FAT		CARBOHYDRATE		CALORIES
TYPE	C C	GM	C C	GM	%	GM	%	GM	%	
Human	180		0	2.2	7	6.7	50	12.9	43	1[illegible]0
Cow's										
Whole	1[illegible]	13	50	3.5	13	3.5	27	17.8	60	1[illegible]0
Lactic acid	140	6		4.8	16	5.5	41	12.9	43	120
Evaporated	[illegible]0	6	80	4.8	16	5.5	41	12.9	43	1[illegible]0
Powdered half skimmed										
(Alacta)	18	11	1[illegible]0	6.0	20	2.2	16	19.4	64	120

Other conditions arise in which diet modification is temporarily necessary. *Vomiting frequently accompanies a minor upset.* This does not necessarily mean that food should be discontinued but that the temporary decrease of total intake may be helpful. Plenty of water should be offered and the child under no circumstances should be forced to eat. If diarrhea occurs the food should be stopped and water given. Feeding should be resumed slowly. The diarrhea may result from a formula too high in carbohydrate or too high in fat. In either case permanent adjustment must be made. Conversely constipation may sometimes be corrected by increase in these food constituents.

*J. A. M. A. 128: 283. 1945

A diet high in sugar and low in protein is a laxative diet. One low in sugar and high in protein tends to be constipating. Sugars, *in general, have a laxative effect, some more so than others.* Dextrose is highly fermentable, but is absorbed quickly in the upper part of the intestinal tract and has, therefore, the least laxative effect. Lactose is slowly broken down, is slowly absorbed, offers the greater chance for bacterial decomposition, and has the highest laxative effect. The malt sugars vary considerably, depending on their composition.

Undernourishment in an infant may be due to an ill adjusted formula, insufficient intake, or to metabolic disturbance. Therapy consists in determining the cause and making the necessary adjustment. The overweight baby may need a decrease in fat or carbohydrate intake, or in both.

Any digestive upset which is more than transitory, and which does not clear with simple adjustment, requires the attention of the doctor to determine the basic, physical cause.

Equal division of the formula into the approximate number of bottles is routine unless the child indicates a preference for more or less at any meal. Starting with six bottles of 2½ to 3 ounces each, adjustment is made in accordance with total volume and number of meals until at one year it has become 3 bottles of 8 ounces each. (For example see Table 57.)

TABLE 57

AVERAGE NUMBER OF INFANT FEEDINGS PER DAY

AGE (*MONTHS*)	VOLUME OF EACH FEEDING (*OZ.*)	NUMBER OF FEEDINGS *IN 24 HOURS*
1	3	6
2	4	5
4	5	5
6	6	4
8	7	4
10	8	3
12	8	3

The formula is increased in volume and strength depending on growth and satisfaction of the infant, the digestibility and utilization as indicated by consistency and number of stools and gastric effect. Approximately *50 to 100 calories will need to be* added each month—or by increasing the milk approximately

1/2 ounce for every 5 ounces in weight gain, leaving the sugar value unchanged

No two babies react exactly alike to the same feeding plan and no definite rules can be set up Common sense must be used in making adjustments If a baby takes from choice a little more than the ounces that may have been calculated at one feeding, and a little less at another, there is no reason why he should not do so

In the "self regulating" schedule now being used by some pediatricians both the time interval and the amount consumed is left entirely to the preference of the child The child is fed when he cries—presumably because he is hungry Usually after a few weeks a fairly constant schedule as to both time and quantity is established by the child One child for example, departed from the widely used 6 10 2 6 10 2 feeding program to a consistent one of 5 9 12 5 8 in the first weeks of life

A plain milk formula should always be supplemented with orange juice and cod liver oil from the first month

Cod liver oil may be given as early as the end of the first week The amount given will depend upon the potency of the oil used, potency varies widely One fourth teaspoonful is approximately 1 gm of oil and yields 1 500 U S P units of vitamin A and 150 U S P units or more of vitamin D in a good grade of oil Dosage is preferably begun with 10 drops the first day and increased by 10 drops each day until the quarter teaspoonful dosage is reached At 2 months the dosage should be slowly increased to a half teaspoonful daily, at 4 months to three fourths teaspoonful, at 6 months it is frequently increased to a full teaspoon The teaspoon level yields about 7,500 to 10,000 units of vitamin A and 750 to 1,000 units of viamin D This is roughly double the recommended need for the child

When *concentrates* are used, a standardized dropper accompanies the bottle This dropper yields approximately 50 drops to the dropper Since concentrates are roughly 25 times as potent as the fish oil dosage is less Roughly, one drop is equivalent to 1,000 I U vitamin A and a proportionate amount of vitamin D Dosage, therefore, is from 3 to 7 drops daily, again a gradual increase in number of drops from one to maximum desired is preferable to immediate use of the maximum amount

Orange juice may be added at the end of the second or third week From one teaspoonful of juice a slow increase may be made until 1 ounce (2 tablespoonfuls or 6 teaspoonfuls) is being given *by the second month* Fresh, frozen, or canned orange juice are equally satisfactory At the third month 3 tablespoonfuls should be given, and at the fourth month 4 tablespoonfuls etc (See Table 58) Six tablespoons or 3 ounces, *equivalent to approximately* 50 mg vitamin C, may be continued through childhood If the juice is not well tolerated, tomato may be substituted, but twice or, better, thrice the amount must be given Four times as much is required if pineapple juice is used *Supplementation by commercial ascorbic acid must sometimes be* made if a deficiency of vitamin C is to be prevented Too great a bulk of fruit juice may displace other dietary essentials, and this must be guarded against

Pediatricians differ in the order in which they recommend *additions to the diet, and the babies do equally well* The suggestions below represent *only one order* which may be used Especially is this true in regard to meat, egg, and wheat The child's own need or response may also be an influencing factor

Cereals may be given in the second or third month Any well cooked cereal may be used, if it is strained to remove coarse particles Long, slow cooking (1 to 1½ hours) in a double boiler to soften the starch grains is important (see discussion under Cereals, Chapter 3) Salt should be added to the cooking water to bring out the natural sweetness of the cereal and to insure palatability without the addition of sugar *The cereal may be* thinned at the time of serving with some of the formula One teaspoonful twice daily, with gradual increase until at 5 months *the baby takes 1 tablespoonful twice daily, at 6 months 2 table* spoonfuls twice daily, and at 9 months 4 tablespoonfuls twice daily, is a satisfactory schedule of feeding *Due to the sensitivity* which some babies show to wheat some physicians withhold wheat cereals until the child is approximately 6 months old

Egg yolk At the age of 3 months egg yolk from hard cooked egg may be added to *the baby's diet if this is the practice of the* attending physician Again the possibility of allergy causes some to withhold egg until after the first six months The reason for the early inclusion of egg yolk is to compensate for the low

iron content of milk, and so prevent the occurrence of anemia Beginning with a quarter teaspoonful of egg yolk, the amount should be increased gradually until the entire yolk is taken Or, if preferred, the yolk may be made into a custard, using formula as the milk, and the custard may be fed separately or added to the formula From 1 to 4 eggs weekly may be given during the first year

Vegetables are usually fed at the end of the third or at the beginning of the fourth month They should be strained until the end of the first year After the first year they should be served as diced vegetables The usual directions for cooking vegetables i e, in a small amount of salted boiling water, should be followed The cooking water may be used to moisten the strained vegetables As usual, the feeding starts with one teaspoonful and is increased until 3 to 4 teaspoonfuls are taken at 6 *months* *Butter or margarine in small amounts may be used* as seasoning Care should be taken that new vegetables are not added to the list too rapidly Sufficient time should be allowed between additions to make sure that no allergic response will develop from the new vegetable

Fruit is added next At 5 to 6 months of age a child may have cooked, strained fruit daily—apricot, peach, prune, apple, plum, or pear Baked or mashed raw banana may be given The amount of fruit may be increased to 3 or 4 tablespoonfuls daily by the end of the first year

At about 7 months the child may munch on dry toast (Melba toast) or Zwieback Children differ in their ability and desire to chew solid food

Meat is a matter of controversy, until recently, it was usually added in small amounts at around 8 months, beef, lamb, turkey, chicken, and liver, carefully broiled or roasted and finely chopped More recently, entire meat preparations in both puréed and chopped form—beef, veal, lamb, pork, beef heart, and beef liver—have become available These not only have been effectively used in the early months of life, but when added to the formula of the premature baby are reported to improve progress Dr Jeans thought "meats appropriately prepared may be fed at any age" Again, small amounts are fed at first (one teaspoonful), and one variety is fed for a sufficient length

of time to rule out allergy The amount is increased gradually until by the end of the first year 1 ounce (2 tablespoonfuls) is taken Meat is alternated during the first year with egg—meat three times weekly and egg yolk four times weekly

TABLE 58

To tabulate the *foregoing*, for convenience, the menu *might* be

At 4 Months of Age

6 A M	6 oz milk
8 A M	2 oz orange juice
10 A M	1 tbs cereal
	6 oz milk
	cod liver oil
2 P M	egg yolk or vegetable
	6 oz milk
6 P M	6 oz milk
10 P M	6 oz milk

At 6 Months of Age

6 A M	7 8 oz milk
8 A M	2 oz orange juice
10 A M	1 tbs cereal
	7 8 oz milk
	cod liver oil
2 P M	3 tbs vegetable
	egg yolk
	7 8 oz milk
6 P M	1 tbs cereal
	7 8 oz milk
	1 tbs fruit
	cod liver oil

At 10 to 12 Months of Age

7 8 A M	2 3 tbs cereal served with part of milk—balance of 8 oz served in cup
Noon	2 tbs meat
	2 3 tbs vegetable
	2 3 tbs simple pudding
	piece crisp toast
	8 oz milk
Mid P M	3 oz orange juice with cracker
5 30 6 30 P M	3 tbs cereal (or vegetable soup)
	3 tbs fruit
	8 oz milk

The fish oil or concentrate may be given at any convenient time

TABLE 59

ANOTHER SCHEDULE WHICH MAY BE FOLLOWED IN FEEDING NORMAL INFANTS DURING FIRST YEAR

AGE MO	0	1	2	3	4	5	6	7	8	9	10	11	12
Wt gm.	3 400	3 850	4 750	5 750	6 450	6 900	7 450	7 800	8 150	8 370	8 700	9 050	9 530
Milk % wt	14	14	14	13 0	13	12 5	12 3	12 1	12				
Milk, c c	450	540	600	780	840	870	900	945	1 000	1 000	1 000	1 000	1 000
Karo c c	22	[illegible]	23	9	41	43	30	15	0	0	0	0	0
Calories	395	475	585	685	737	760		-		-	--	--	953
Cal /kg	115	123	123	120	115	110		-			--	-	100
Milk oz.	15	18	22	26	28	29	30	31	32	32	32	32	32
Karo tbs	1½	2	2¼	2½	3	3	2	1	0	0	0	0	0
Cal /lb	53	55	55	54 5	52	50		-		--	--		45
Wt lb	7 5	8 5	10 5	12 7	14 2	15 2	16 5	17 2	18	18 5	19 2	20	21
Cod liver oil		¼ tsp -	½ tsp		¾ tsp		1 tsp				-	-- --	---
Orange juice or double tomato juice		1 tbs	2 tbs	3 tbs	4 tbs		5 tbs		6 tbs	-		-	
Egg yolk				¼ tsp –		½ tsp	entire yolk				-	-- -	-----
Cereals					1 tsp × 2		2 tbs × 2	--	4 tbs × 2	--	--	---	---
Vegetables						1 tsp	up to 4 tsp		2 tb	---	-	-- -	- -
Strained fruit								1 tbs × 1	2 tbs	- -	3 tbs	- -	4 tbs
Toast								1 piece		-----	--- -	--	---

Meat Inclusion date optional Ca be added in pureed form as early as first month It probably should be added by six or seven months

Thus, by the end of the first year, the child's diet is complete and further changes will be minor

The *time of weaning from the breast*, as pointed out in Chapter 18, will probably be in the third quarter of the first year, unless premature weaning is found necessary It is desirable to wean a child directly to a cup rather than to a bottle Alternate breast feeding and cup feeding as a means of weaning is helpful in the establishment of future eating habits

A feeding schedule is important for the sake of the mother's routine and habit formation in the child However, adherence to any rigid schedule in the early weeks of life is being abolished by many pediatricians The child who is allowed to adjust his preferences in time and amount, rather than having these set forth for him, is usually the happier child In the first weeks of life the child will usually be fed *approximately* every four hours around the clock On a four hour schedule the time for feeding is usually 2, 6, and 10 o'clock in the morning, and 2 6 and 10 o'clock in the latter half of the day *The actual schedule will depend on the convenience of the mother and the preference of the child The baby must not disrupt the family life, he should take his place and add to the family's pleasure* For the sake of convenience however, such a time plan will be followed here

By the end of the first month, or perhaps the second, the feeding coming at 2 o'clock in the morning is omitted This may be done as soon as a satisfactory weight gain is established Most children will voluntarily omit this meal once the need for it ceases Near the end of six months, the 10 o'clock feeding at night may be omitted, depending on the condition or the desire of the child

Cod liver oil or fish oil product may be given after any of the feedings, first as one dose, and later when the amount is increased as two doses if desired

Orange juice or other source of vitamin C is usually given between meals at about 8 o'clock in the morning It may be given alone or it may be diluted slightly with water if desired For some babies it may be wiser to give the orange as part of a meal instead of on an empty stomach Some babies are apparently sensitive to the organic acidity of the undiluted orange juice and may ' spit it up " Also as with other foods allergy may be present Care must be used in expressing the juice from

the orange The oil in the skin may have an irritating effect on the baby's tender skin At times this irritation may be mistaken for an allergy Careful *wiping of child's mouth* after fruit juice feeding or any feeding is important

The cereal when added is fed at 10 A M and later as more is given also at 6 P M The vegetables and egg or meat are added at 2 P M and thus the egg and vegetables become the forerunner of a noon dinner The fruit next increases the supper meal at 6 P M and the basis for the three meals a day is at last established

Exact quantities of food cannot be planned to meet the child's appetite Judgment must be used in quantity of serving A normal healthy child will satisfy himself within a reasonable time limit without force or coaxing if moderate quantities of mildly but palatably seasoned reasonably attractive food is served at the proper temperature Fussiness over quality of food is undesirable but the child is entitled to good meals He will learn to like more foods if care is used in their preparation

Coaxing a child to eat is psychologically bad and should not become a habit

At the end of the first year the child on a three meal a day schedule should be taking his vegetables fruits and cereals unstrained he should be eating dry crisp toast meat and egg and drinking milk orange juice and water from a cup

Water boiled and cooled should be offered between meals throughout the day especially if the day is warm

The problem of infant and child feeding is an ever present one and one upon which many have written One of the most logical dissertations heard on the subject was by Dr Aldrich when he talked about Ancient Processes in a Scientific Age He discussed the effect of the impact of the new techniques in baby care on the child's ancient mechanism for in the newborn child is a living replica of the first individual born so many centuries ago In the training process the child is under the compulsion of two forces The first is the drive to grow according to his preordained pattern—physically emotionally and mentally The second is the authoritative routines of a scientific age which among other things tell the child when and how much to sleep and to eat This frequently results in conflicts which are not really the baby's fault

The newborn baby is born with reflexes which are concerned with the actual getting of food—rooting, sucking, swallowing and satiety reflexes. The first reflex to come into play is the one which causes the child to root—to move his head when he smells food in an effort to find its source. If one cheek is touched by a smooth object he will turn his mouth toward that object and open it in anticipation of grasping the food. Pressure applied to a baby's head in an effort to guide him immediately to the nipple invariably results in resistance and frequently arouses a feeling of displeasure in the child. To add to his discomfort it may seem necessary to "rouse" him by any of the little tricks used for that purpose. Most newborn babies are drowsy as an aftereffect of the sedation administered to the mother. All of this takes place at a time suited to his planned program, not his desire for food; hence, a pleasurable connection between hunger and the ingestion of food may not immediately develop as Nature intended it should be. If for the first few days of life it is possible to permit the child to eat in response to hunger, to let him root for his own food, even though he dozed a bit, a worth while association between hunger, eating, and pleasure might be developed. Once this is established, it would take but a few more days to gradually introduce a routine.

The hunger appetite mechanism fares differently in the modern hospital or under a "scientific" regime. The baby's rhythmic hunger pains are completely ignored in his schedule for feeding. As Dr. Aldrich expresses it, the newborn baby who wakes up with a stomach ache and announces his epigastric crises by shrieking cries does not meet with the reponse Nature intended for him. Instead of being picked up and given something to eat too frequently he is forced to wait until the clock on the wall moves around to the approved hour, at which time, sleeping or screaming, he is picked up and made to eat. A slow transition from the natural way to a set program may prevent later feeding problems. Once the happy association is established between hunger and food, and between eating and food, it will carry over into later life.

By careful watching rather than by date, the child should be introduced to thick foods. When the lips open and the tongue actively takes nourishment back so that swallowing is easy, is the logical time to offer foods which are of thicker consistency.

than milk When the child makes chewing motions, lumpy or solid foods should be given—not before and not later

If a mother observes her child carefully and intelligently, she will find that automatically, if he is well, he will sleep through first his 2 A M and then his 10 P M feeding, and he will shift his nap time from morning to afternoon at just about the accepted time to go over onto the three meal schedule To let these re adjustments be natural ones is certainly preferable to forcing a change prematurely Babies, Dr Aldrich contends, are ac commodating sort of persons and adjust readily if permitted to do so in a logical, natural manner

Review Questions

1 Enumerate the advantages of breast feeding, those of formula feed ing
2 Why is sugar in some form added to milk in formula feeding?
3 What advantages does evaporated milk have in contrast to fresh milk in formula making?
4 What supplementations does any milk formula require? At what age are these supplements added?
5 At what age are the first solid foods given? Why are those particular solid foods added?
6 In introducing solid foods what precaution should be taken?
7 At what age should a baby receive a full quart of milk daily?
8 What may be said in regard to a rigid schedule of feeding vs a more lenient one of eating in response to hunger?
9 What factors should govern additions to the infant diet?
10 How does the metabolic rate of the infant compare with the adult?
11 How does the protein requirement compare? Why?

Suggested Projects

1 Interview a mother of a young baby Obtain the formula that she has been feeding the baby How does the child react to the formula, what foods have been added and when were they added?
2 Interview the mothers of several infants from 6 months to 1 year Find out when foods were added to the diet of the baby How did each child react to the addition of the new food? What had been the child's physical progress in respect to his rate of growth?
3 Do you know any infants who were fed a formula composed of milks other than evaporated milk? Which product was used? Compare the formula with the information in Table 54 for calculating the usual formula

CHAPTER 20

FOOD FOR CHILDREN

Nutrition is an important factor in the growth and development of children During the preschool period the child develops muscularly and grows in height The establishment of good food habits may begin to take place at this time The school child continues to grow steadily His food habits should be carefully supervised as he may eat one meal a day away from home The nutritional demands of adolescence are exceedingly high, however, surveys indicate that the intake is likely to be deficient in many nutrients Several methods may be used in evaluating growth which is one of the major indications of good nutrition

A discussion of foods for children seems to fall naturally into three groups the preschool child, or the child from 1 to 6, the school child, or the child from 6 to approximately 12, the adolescent, or the years from 12 to 20 However, it must be recognized that these are only convenient classifications, not finite Many children will not fit into specific categories and there is wide overlapping from one group to another in terms of growth and development and subsequent food needs Not only will the nutritive requirements be considered for these three periods, but the behavioral patterns of the child in relation to food will also be reviewed

The food pattern of the infant during the first year of life is described in Chapter 19 It will be remembered that the last three months of pregnancy and the first three months after birth represent the period of most rapid growth of the life of the individual Thus, there is the highest food requirement per unit of body weight during this time

After this time however, the growth rate diminishes steadily to the lowest level of childhood, which is approximately 2 to 3 years of age The child may continue at this plateau for usually about two or three years The food needs per unit of body weight are relatively low at this time The rate of weight gain and the relative metabolic rate are also at a low level

In early years the protein intake should be at a level of 3 to 4 gm per kilogram of body weight or should supply roughly 10 to 15% of the total calories. This protein should be of high biological value. Milk is the protein of first choice. The child's diet should continue to contain the liberal amounts of milk which had been included in his diet during infancy (From 1½ pints to 1 quart per day, see Normal Diet.) If this proves to be too great in bulk, the use of powdered milk added to the smaller amount of fluid milk or the use of powdered milk in cooking is practicable. The continued use of egg and meat will supply adequately the remainder of animal protein. This will be supplemented by cereals to make up the required amount.

Jeans in his *Essentials of Pediatrics,* summarizes the approximate protein and energy requirements of children in Table 60.

The importance of protein of high biological value is emphasized by Stearns. She pointed out that during the period from 1 to 3 slow body growth takes place. The protein needs are high as it is a time of changing body composition. The musculature grows far more rapidly than the rest of the body if the protein intake permits such growth and development. It must be remembered that the utilization of protein by the body is dependent upon total energy intake. This is especially important during the preschool age.

Apart from providing the necessary nutrients the family must establish good eating habits and healthy attitudes toward foods.

TABLE 60*

AGE (YR.)	APPROX. HT (IN.)	APPROX. WT (LB.)	AV. PROTEIN (GM.)	AV. OF TOTAL CALORIES
1	30	[illegible]	30	1 000
2	34	2	32	1 100
3	37	3	35	1 250
4	40	36	37	1 375
5	43	41	41	1 500
6	46	48	48	1 600
7	48	52	52	1 750
8	50	58	58	1 900
9	52	64	64	2 050
10	54	1	71	2 200
11	56	78	78	2 400
12	58	87	8	2 600
13	60	95	95	2 800
14	63	110	100	3 000
15	65	120	100	3 300
16	67	130	100	3 500

*From Jeans, Essentials of Pediatrics, reproduced with the permission of J. B. Lippincott Company.

in the child during this preschool period When the child is approximately 18 months old, he may begin to show a decrease in appetite that continues through the second and third years This decrease in appetite corresponds to the diminished growth rate Frequently the mother does not understand that this is likely to take place She will coax the child to eat more than he desires or needs and a battle over food takes place at each meal This action on her part may bring about eating problems

The young child, from 18 months to 2 years, may begin to express definite food preferences and likes and dislikes Some mothers have reported that children can distinguish between different brands of the same food As the chewing mechanism becomes more developed, meat becomes a favorite food The child may demand repetition Sometimes, during the period of 1 to 3 years old, the traditional "one quart of milk a day" has to be modified A pint of milk may be easily taken and the remaining pint served in cheese, or in cooking, such as custards or puddings Milk fortified with powdered skim milk will permit higher value with lower volume

The 3 year old or the 4 year old child may go on food jags and food strikes If the adults can overcome their dislike for the same food served daily for several weeks, this period will come to its natural end Again, this is a time when adult standards are thought best not to be imposed upon children At this age, desserts and sweets may be more desired and green vegetables more acceptable Raw vegetables are well liked Many foods may be accepted raw and rejected if served cooked

On the basis of extensive work with many children, Lowenberg makes many valuable suggestions about feeding the preschool child Some of these are always take the child's point of view, do not worry about the table manners of very young children remember children prefer lightly seasoned foods, study the child to learn how he prefers his foods cooked, keep mealtime conversation happy and cheerful give children a choice between two fruits or vegetables and let them serve themselves, use lots of finger foods keep foods simple, keep helpings small and let the child ask for more serve spoon eaten foods in small bites which are easy to pick up and introduce new foods in small amounts, one at a time

TABLE 61

RANGE OF AVERAGE WATER REQUIREMENTS OF CHILDREN AT DIFFERENT AGES UNDER ORDINARY CONDITIONS

AGE	BODY WT (KG)	TOTAL WATER IN 24 HR	WATER (KG/24 HR)
3 days	3.0	210–300	80–100
10 days	3.2	400–480	125–150
3 months	5.4	750–850	140–160
6 months	7.3	950–1,130	130–155
9 months	8.6	1,075–1,240	125–145
1 year	9.5	1,140–1,300	120–135
2 years	11.8	1,350–1,475	115–125
4 years	16.2	1,600–1,800	100–110
6 years	20.0	1,800–2,000	90–100
10 years	28.7	2,000–2,440	70–85
14 years	45.0	2,250–2,700	50–60
18 years	54.0	2,100–2,700	40–50

When the child is 4½ or 5 he observes what others eat and he is likely to be influenced by group patterns. He then becomes less demanding and is willing to accept foods given to him.

The water intake in early childhood continues to be of importance. In the White House Conference Report on nutrition the amounts in Table 61 are suggested.

There is considerable difference of opinion as to the most desirable time to have the child begin to eat with the family. Some suggest that as soon as he can sit in a high chair he should have one of his meals, or part of it at least, at the family table. This, of course, presupposes the mother's willingness to tolerate untidiness. However, Ilg suggests that eating habits are better established if the child is fed apart from the family as late as the 2 to 3 year period. She also indicates that at 3½, the child is often ready and wants to come to a few family meals. If this is the case, she thinks that breakfast is the best meal to start this pattern. Ilg believes that from 7 on the child becomes part of the family group. However, most find it practical to have young children eat with the family at an early age.

Thus the period from 1 to 6 is one of change. There are times of rapid growth with a subsequent diminished rate of growth. However, it is also a period of muscular development. The nutritive needs for protein, vitamins, and minerals are high, yet the appetite may be diminished. The child asserts himself with respect to foods. The mother's responsibility is to realize that how

and where the child eats is as important a part of eating as wha he eats The establishment of good food patterns can take plac during this period. As Ilg so aptly said, "Be ready to listen t

The Same Menu for All

DINNER
Broiled Meat Ball
String Beans, Baked Potato
Bread and Butter, Lettuce
Baked Apple
Milk

Small Servings for the Two-Year-Old

Medium Servings for the Six-Year Old

Very Generous Servings for the Ten-Year-Old

Wholesome Food Simply Prepared Suits the Whole Family

FIG. 60—The same menu for all (Courtesy Bureau of Home Economics United States Department of Agriculture)

the child He often talks more sense than we realize He needs experience in eating as in everything else, but one should consider for what eating experience he is ready"

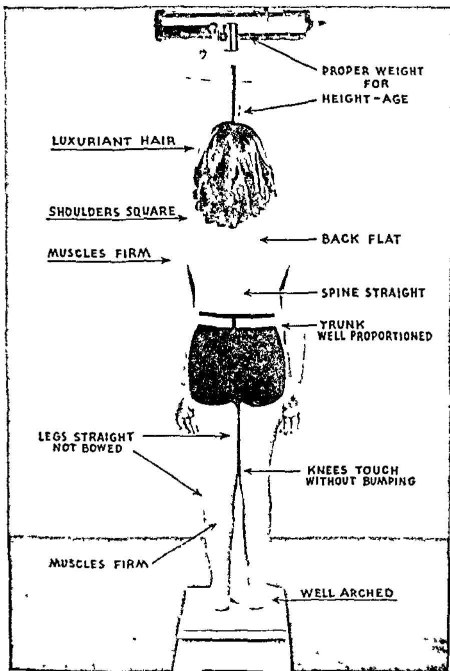


Fig. 61.—The healthy child. (Courtesy California Fruit Growers Exchange.)

The period when the child is from 6 to 12 is characterized by continued growth It may be relatively slow, however, height and weight will progress steadily Some changes in height and weight should be discernible within each 3 month period It is during this time that permanent teeth erupt and the completion of calcification occurs (See Chapter 14) Muscular development continues, at first in the large muscles of the arms and legs and then in the small muscles

Usually at 6, and through the school period, the child exhibits a large appetite He may be described as a "wonderful eater" He still has strong preferences and may refuse some foods However, as he grows older, he becomes more and more venturesome and ready to try any food He still prefers simple foods, though, and does not like foods combined in unknown dishes His nutritive needs increase with his age, and are especially high in protein, calories, vitamins, and minerals The Food and Nutrition Board considers the needs of boys and girls together until the age of 10, after which they designate different recommended allowances

Numerous surveys have indicated that the school child does not receive recommended amounts of the necessary nutrients According to Jeans, the nutrients most commonly found deficient are riboflavin, calcium, thiamine, and ascorbic acid In addition he believes that protein and vitamin D deficiencies are relatively common in childhood In a survey conducted by General Mills, Inc on the eating habits of 59,727 school children in thirty eight states (published in 1951), it was found that 33% of the children ate diets that were classified as good, 27% as fair, and 40% as poor They found that breakfasts were usually poor and that the diet picture was essentially the same in rural, small town, and urban communities when economic levels were not considered Even though there is evidence to suggest that the nutrition of the school child has been improved during the past generation there is additional data which indicate that there is a great deal to be done in educating the child and his family in regard to his nutritional needs at this time

The school age child begins to assume the responsibility for many of his own meals for the first time He may eat lunch away from home If there is a school lunch program in his community, he will become acquainted with new foods and he will have many

social experiences in relation to eating He will have the opportunity to express his own food preferences by refusing to eat foods that are served If good food habits and good attitudes about food have been established before the child comes to school he will be prepared to assume these new responsibilities

If lunch is taken from home, or if the school child comes home for the midday meal the menus can be planned to include part of the total day s needs In some cases the parents receive the menus from the school lunch a week in advance This allows the mother to plan the family meals so that there is no repetition and it also affords an opportunity to educate the school child in the proper selection of food away from home

It must not be forgotten that the after school snack may contribute necessary nutrients Frequently this important "small meal" is unplanned As a result of haphazard selection little but calories may be obtained If only sweet foods or those high in carbohydrate content are consumed the child s appetite for his main meal of the day and one that contributes a large share of important nutrients may be dulled Thus the after school snack and the evening snack if usually eaten should be carefully planned to contribute their share of the total day s needs

In many communities today nutrition education is being integrated into the elementary school curriculum Learning experiences are planned according to the developmental level of the child For example in the lower grades unfamiliar foods are prepared and Taste Parties are held It is thought that the students might then try these new foods at home In other schools the students help plan the menus for the school lunch Arithmetic is taught by using real problems with foods as illustrations Spelling is learned by making posters or writing the school lunch menus Evaluation of such programs has shown that attitudes toward foods have improved and in many cases better diets are eaten

The **adolescent** period is one of highest nutritional requirements The onset usually occurs from ages 10 to 12 in girls and from 12 to 14 in boys Growth is extended in all directions it accelerates and continues to a maximum peak of gain in about two years After this the growth rate diminishes rapidly However, during later adolescence after the growth in height has begun to diminish there continues a period of rapid growth of

muscles Thus, the nutritional needs are high throughout all the *adolescent years Table 3 demonstrates that the recommended* allowances of the Food and Nutrition Board suggest a level of nutrients to meet these excessive *demands*

It has been found that the food habits of the teen ager are the worst of all groups *A survey of the diets of thirty three Ne*braska families by Leverton showed that the mothers ate the poorest diet except in families in *which there were teen aged girls Then the girls ate the poorest diets and the mothers the* next poorest

Steele reported on the *food habits of a group of New York* State children Of all age groups, the adolescent girl consumed a diet that rated the poorest of all *Only* 36 to 39% of the diets met the recommended dietary allowances for this age group The diets were lowest in protein, iron, thiamine, riboflavin, niacin and vitamin C *Calcium was lacking at all ages* The adolescent boys were better, as approximately 50% of their diets met the recommended dietary allowances Not only were the diets inadequate in essential nutrients but the menus reflected undesirable food patterns The lunch frequently consisted of hot dog soft *drink and candy bar type meal* Skipping meals was prevalent particularly among the girls and the survey revealed poor breakfast habits It is interesting to note that the adolescent obtained about *one tenth of his calories* from snacks

Research has suggested that an individual performs at his best *only when he receives from one fourth to one third* of the day's calories at breakfast In the light of information disclosed in surveys regarding poor breakfast habits, nutrition education should be directed toward improving these patterns

Mack and her co workers analyzed the food habits of 3 109 *teen aged boys and girls during a period of* ten years from 1941 to 1951 In addition, a detailed physical examination was part *of the study* Briefly stated it was found that neither the boys *nor the girls* met the amounts recommended by the Food and Nutrition Board *of any* of the nutrients included Of course the intake varied *among* the nutrients however the girls were lowest in calories *protein, iron* thiamine and niacin while the boys were lowest in calories iron thiamine, and niacin The diets of the boys were better *than those of the girls* It was also

found that the teen agers with the poorest physical conditions were those with the poorest food habits

The seriousness of these inadequate food patterns is recognized when research has emphasized the importance of a good nutritional preconceptional state Pregnancy often closely follows the adolescent years As Stearns pointed out A girl or young woman entering pregnancy after years of malnutrition and maintaining her customary diet adequate in calories but low in many nutritional essentials cannot possibly nourish her fetus well in the critical first 2 months of development in utero Evidence is accumulating that excessive nausea is more common among the poorly nourished pregnant women It is not strange that the incidence of abortion stillbirth and premature births tends to be high in this group In order to assure the birth of healthy infants carried to term the mother s diet should be nutritionally adequate from early childhood so that she enters pregnancy with a full store of nutritional essentials Thus we come full circle

One of the great concerns of the teen aged girl is that she retain her slim figure Many of her poor eating habits are determined by that factor If she can be made to realize that other aspects of her appearance are influenced by the foods she eats such as her skin hair posture and her vitality she may modify her present food habits and include items that are necessary for her general health The adolescent boy is desirous of improved physical prowess and stamina and improved physical appearance Through these avenues he may be persuaded to improve his choice of foods

The adolescent needs to be able to make wise food selections Many do not live at home as they may go away to school when they are 17 or 18 Many social events center around eating such as parties after school gatherings at drugstores or homes and dating These occasions offer opportunities to increase the protein calcium and riboflavin content of the diet as well as the calories by selecting a food that is as socially acceptable as another

Table 62 indicates how the foods in the Basic Seven may be adapted to meet the needs of each age group The calorie needs, of course will vary with each individual child The slogan the busy mother should be one menu for all' It is a

ADAPTING THE FOODS FROM THE BASIC SEVEN ...*

HOW MUCH OF	LEAFY GREEN AND YELLOW VEGETABLES	CITRUS FRUITS, OTHER HIGH VITAMIN C FOODS	POTATOES, OTHER VEGETABLES AND FRUITS
Children 1-3	Consult your doctor	Consult your doctor	Consult your doctor
Children 3-6	¾ cup	½ cup	
Children 7-11	¾ cup	½ cup	
Children 12-15	¾ cup	½ cup	1 medium cooked potato and 1 serving each other vegetables and fruits
Good sources	Asparagus, broccoli, Brussels sprouts, spinach, green beans, peas, salad greens, carrots, yellow squash, pumpkins, sweet potato	Oranges, grapefruit, tomatoes or their juices, lemons, limes, tangerines, if eaten raw, cabbage, salad greens, green peppers	Potatoes or spaghetti, macaroni, rice, dried beans. Other vegetables: raw cabbage, celery, cucumber, beets, onions, cauliflower, noncitrous fruits

*Adapted from Table "Your Child Needs at Least These Amounts of the Basic Seven Foods Daily" in "You Can Lengthen Your Child's Life" by Dr Herbert Pollack, *Woman's Home Companion*, December 1953. Reprinted by permission of the author.

of increasing quantity of food intake rather than changes in type of food which should be continued throughout childhood, with the exception of fried foods, tea, coffee, and rich desserts, which after all should be used in only limited amounts in any dietary.

One of the criteria for good nutrition in children is their growth and development. There are other criteria for good nutrition (see Chapter 26) and other factors that affect growth and development. Most of these are beyond the scope of the present book, but some may be mentioned here. Although some influences are not clearly understood, it is generally believed that disease, heredity, action of hormones, rest, fatigue, exercise, and perhaps seasons of the year are factors which affect growth and development.

Growth and development are not synonymous terms. Shelton and Skeels differentiate between the two with the following defi

ET THE NEEDS OF CHILDREN OF VARIOUS AGES

MILK, CHEESE, ICE CREAM	MEAT, POULTRY, FISH, EGGS, DRIED PEAS, BEANS	BREAD, FLOUR, CEREALS	BUTTER, FORTIFIED MARGARINE
nsult your doctor	Consult your doctor	Consult your doctor	Consult your doctor
cups fluid whole milk or the equivalent	2 oz meat, fish, or poultry, 1 med egg	3 slices whole grain or enriched bread or the equivalent	4 level teaspoons
cups fluid whole milk or the equivalent	4 oz meat, fish, or poultry, 1 med egg, 2 servings a week dried peas or beans	6 slices whole grain or enriched bread or the equivalent	6 level teaspoons
cups fluid whole milk or the equivalent	4 oz meat, fish, or poultry, 2 med eggs, 2 servings a week dried peas or beans	8 slices whole grain or enriched bread or the equivalent	6 level teaspoons
asteurized or fresh unsweetened evaporated or powdered milk, goat's milk, skim milk, also cheddar, cream or cottage cheese, ice cream	Beef, veal, lamb, pork, canned salmon or tuna, sardines, fish and shellfish, poultry, wild game, liver, kidneys	Whole wheat or whole rye flour, whole cornmeal, whole wheat or dark rye bread, brown or converted rice, whole grain cereals, noodles, spaghetti, macaroni	Butter and vitamin enriched margarine, cream, yellow cheese

nition "Growth is accomplished essentially by cellular multiplication, with increase in number and/or size of tissue units. Development, on the other hand, is that process which leads to differentiation into specialized functional tissues and which normally occurs concurrently with growth. Accurate definition of these terms is not merely a matter of semantics. A thorough understanding of these two processes is an important aid in the differential diagnosis of the child who is well grown but poorly developed from one that is poorly grown but well developed. Maturation may be considered the end result of normal growth and development."

Since nutrition is one of the major factors that influence growth and development, body measurements are usually included as a method of evaluating nutrition studies and surveys. Such measurements are usually kept as part of a child's health record. Various systems of measurement have been developed

whereby a child's record may be interpreted in relation to a given standard In some cases, the standard is an average, and in others, the child serves as his own standard The systems in general use will be described briefly For complete descriptions and illustrations, original references are listed in the Appendix



Fig 62—The process of good nutrition is a continuous one the nutrition of a child at any period in life is dependent on that of all preceding ones The difference in body build shown by these girls is not related to age or to nutrition All three are 8 years old and all are well nourished Photograph by Bureau of Human Nutrition and Home Economics (BHNHE) of the United States Department of Agriculture (USDA)

In the past tables of average heights and weights at given ages were widely used This was based on the assumption that a child who differed very much from the so called normal stand-

and was not growing successfully. (See Tables 132, 133, 134 and 135 in the Appendix.) It was recognized that there were natural differences in body build so that a child who might be judged undernourished from the average height weight tables might be in good health. Fig. 62 demonstrates a difference in body build of healthy children of the same age. Some tables have been developed again expressing an average which include classifications of body build in descriptive terms such as "short stocky type" and "tall slender type." The difficulty in using these lies in deciding to which type a child belongs. It is frequently the teacher who will note the height weight measurements and she has not been trained to judge the body build of her pupils.

Recording the height and weight of children can serve as an indication of progress in growth if these measurements are related to previous heights and weights of the same child. It is in this context, as a measurement against his own record instead of a table of average heights and weights, that these values are used today.

Pryor has developed Width Weight tables to be used in evaluating the growth of the individuals. These are based on the belief that tables of height, weight, age and sex do not properly consider the nature of the bony framework and the body structure of the individual. These tables may be used to predict body weight in terms of width of hips and width of chest as well as height for each age and sex. Pryor states that width length indices calculated every six months over a seven year period on one hundred adolescent girls and one hundred adolescent boys were found *very reliable in predicting body build during the period of most rapid growth*. These width weight tables may be regarded as predicting body weight in terms of width of hips and width of chest as well as height for each age and sex. Again the child may be followed in his own path of development.

Another method of evaluating growth and development is the Wetzel Grid. The grid is a chart worked out by Wetzel of Cleveland which may be used to follow the growth pattern of the child. The grid contains nine patterns of growth, each schedule expressed as a channel. These channels represent nine body types and patterns of growth found in each body type that

Wetzel found in his analysis of data from his observations upon thousands of children The child's position on the Wetzel Grid is plotted from data normally obtained at a physical examination, height, weight, and age His channel depicts his body build and predicts his normal growth Thus, when a child "wanders" out of his normal channel, it may serve as an indication that he is not growing as expected and further examination is indicated The grid also recognizes that each child is different from other children, it is a continuous record that compares each child with himself There are other ways in which the grid may be used, however, the information may be obtained from the references in the Appendix

Two other charts which are used for evaluating the growth and development of the child are from data gathered in Iowa and from data gathered in Massachusetts Meredith compiled the data for the former and Stuart and his associates the latter The "Iowa charts" are designed for situations where it is not practicable to adopt a program calling for more measurements than height and weight From these data, which are plotted on the child's chart, the following information may be obtained a ready description of the child's over all body size at each of the ages that measurements were taken, the relation of a child's height and weight to others, and the record furnishes leads on possible deviations as a child's growth is plotted year after year Other information may be obtained from continued use of these records

The "Boston" charts provide a standard of reference for body weight and height (and from years 2 to 6 recumbent length) of children By plotting these measurements upon the chart, the percentile position of the child is obtained The number of the percentile refers to the position which either measurement of the given value would hold in any typical series of 100 children If a child were at the 90th percentile, 89 children might be smaller and 10 larger than the measured child The 50th percentile represents the median in the customary range Apart from establishing the child's position in relation to others, the graph also allows for ready recognition and description of individual differences as well as the regularity of progress Thus comparisons of percentile positions held at repeated periodic ex

aminations indicate either adherence or deviation from previous percentile positions Normally, it is expected that a child would remain on or near one percentile position Again, in order to appreciate the ways in which this chart may be used effectively, the original reference must be consulted

Thus nutrition is important for growth throughout all periods of childhood Recent research has indicated that how and where a child eats is an important part of the total nutritional pattern Although progress has been made in improving the nutritional intake of children, surveys indicate that there are many children with poor food habits Today, it is recognized that children of the same age differ greatly in size and in rate of growth and speed of maturation The trend in present methods of evaluating growth includes these newer concepts

Review Questions

1 How does the diet of a 2 year old child compare with that of an infant of 1 year?
2 Should the diet of young children differ from that of the adults in a family?
3 What *responsibility have parents and other adults in a family in form* ing correct eating habits in children?
4 How do the food requirements of children compare with those of adults in protein content? Other nutrients?
5 Why are proteins of high biological value necessary in a child's diet for good nutrition?
6 What items should be omitted from children's diets?
7 Is water important?
8 What are the various methods of evaluating growth? What are the characteristics of each?

Suggested Projects

1 Plan a diet for a 4 year old child Compare your menus with the recom mended allowances What plans have you made to provide foods that a child of this age would like?
2 Plan a menu for a family showing how the same foods may be adapted for children of preschool age, 8 years old, and a teen ager
3 Plan a menu for a 9 year old, include an after school snack and a lunch box from home in the diet
4 Plan lunches to take from home for a 17 year old boy What variety in the lunches have you planned and what variations in texture, color, etc, have you included?

5 Plan menus for a 16 year old girl which meet her nutritive needs yet provide foods she will not consider "fattening" Be sure to plan for after school snacks

6 Plan menus for an adolescent boy whose family is on a moderate income Be sure to meet his nutritive needs, and include after school and evening snacks Avoid foods that are concentrated in carbohydrate if possible

7 Interview the mother of a preschool child Find out his menu for one day Evaluate it in the light of the information set forth in this chapter Do the same for a school child, for an adolescent

CHAPTER 21

NUTRITIONAL NEEDS OF THE ADULT

The nutrition of the adult is being studied extensively. With the life expectancy in the United States increasing, a growing percentage of our population is over 65. It is necessary that the contribution adequate nutrition makes to optimum health in the geriatric individual be recognized. The nutritional needs of the young adult and of the individual in middle years should not be overlooked. Recommended allowances provide a guide in planning menus for the adult.

In the 1953 revision of the Recommended Daily Dietary Allowances of the National Research Council the nutritive needs of adults were classified into three groups (see Table 3). This is the first time in the Recommended Allowances that such division has been made. It emphasizes the fact that the nutrition of the adult during the period between the cessation of growth and the beginning of the geriatric era is of extreme importance. This time is important to the adult for several reasons: muscular and skeletal development may still be taking place in the young adult; good nutrition is necessary to maintain optimum health during the productive years or the so-called "prime of life" years; and it is believed that good nutritional habits at this time will affect the health in later years. The three ages indicated in the allowances are 25, 45, and 65. These may be thought of as the young adult, the middle years, and the geriatric adult, respectively. Too frequently the nutritive needs of the 25-year-old and the 45-year-old have been neglected.

It has been pointed out that "much can be done if we emphasize to young persons and those in the middle years that healthy aging is rarely fortuitous; that the earlier in life a start is made in achieving and maintaining optimum health, the more productive the effort will be."*

Today interest is directed toward the nutritional needs of the older person. Little evidence is available concerning the food habits of the first two age groups: the young adult and the so-

*From Man and His Years, Federal Security Administration, Health Publications Institute, Inc., Raleigh, N. C., 1951.

called "middle aged" individual Present information suggests however, that these people are not as well fed as they might be

Swanson reported on a survey of the dietary practices of a group of 1,072 women representing a probability sample for the state of Iowa of individuals ranging in age from 30 to 95 years One of the significant points disclosed was that approximately 86% of the women reported diets providing less than 2400 calories, which is the recommended allowance (1948) of the moderately active woman Swanson further pointed out that it has been shown that "within comparable dietary patterns, the protein content of the diet follows its caloric value In turn, adequate ingestion of protein seems to insure adequate intakes of thiamine, riboflavin, niacin, and iron" The diets of the women from this survey, and others which have shown similar results may be inadequate in many nutrients and probably are leaving nutritional scars that may be reflected in health in later life

Wilder, in an address at the Food and Nutrition Institute in December, 1952, stated that, while frank vitamin and mineral deficiencies are rare in the United States today, data from surveys and experiments in animals and in man suggest that a larger, though indeterminable, number of our adult population still suffers from so called "subclinical" or borderline deficiencies

Another nutritional problem which is prevalent among the adult population is that of obesity This will be discussed in detail in Chapter 22 However, obesity merits consideration at these ages, during the middle years, as its prevention at this time is believed to be an important contribution to health as a senior citizen

Thus even though there is much to be learned about the years in between adolescence and old age it is obvious from the limited information that nutritional needs of the adult must not be overlooked

A quotation from the Borden Review of Nutrition Research titled "Nutrition in Geriatrics" indicates why geriatrics has become an increasingly important phase of medicine The discussion begins with a quotation from *Geriatric Medicine* by Stieglitz *

*W B Saunders Co 1943

Aging is a part of living All living matter ages and as it ages changes Aging involves every one of the innumerable aspects of life It begins with conception and ends only with death Thus growth development and maturation are just as much consequences of the occult process of aging as are the atrophies and degenerations of senility Evolution and involution are both affected by aging pediatrics and geriatrics are closer than many realize Gerontology is the science of aging in the broadest sense The aged and aging are not the same the aged are people aging is a process Whereas pediatrics is concerned with the early stages of the life span geriatrics is that branch of medical science concerned with the physiologic and pathologic problems of older individuals Geriatrics is thus but a part a sub division of the broader field of gerontology "

The quotation continues

Geriatrics is a relatively recent branch of medical science The greatly increased expectancy of life and the large predominance of elderly people in our present population have stimulated an interest in the problems of the aged which has hitherto been almost completely lacking At the time of the Roman Empire life expectancy at birth was approximately 23 years During the next 19 centuries the average rose very slowly reaching an expectancy of 40 years by 1850 and 47 years by 1900 Following the turn of the century the rise has been dramatic life expectancy increasing to about 63 years by 1940 The increase in the brief period from 1900 to 1940 thus almost equalled that for the preceding nineteen centuries In 1900 17 per cent of the population of the United States was 45 years or older by 1940 the number of persons over 45 rose to 26 5 per cent The number of persons now over 65 in this country (approximately nine million) has increased at a rate almost five times the increase in general population rate

The Federal Security Agency* reports that in early 1952 there were 13 million men and women 65 years of age and over Further this number is increasing currently at the rate of about 400 000 a year The increase in the country s population of 65 and over during the period of 1940 to 1950 is amazing This group went up 36% with the increase in California and Nevada

*Fact Book on Aging Federal Security Agency 1952

being 60% or more and in Arizona and Florida, 80% or more This means that one in every twelve persons in the country is 65 years and over

As Stieglitz points out, the present situation is without precedent In earlier centuries, wars, famine, and pestilence have caused severe shifts in population structure but always in the direction of relative increase of youth Improvements of modern civilization and advances in medical science however, have tended to extend the life of the less hardy, so that along with the increase in longevity is the problem of maintaining the health and usefulness of the new millions of the aged

In the first quarter century of life the growth stimulus is great and structural changes are many In the second and third quarters growth and weight are essentially stationary The extent to which health and vigor are retained in the third quarter is dependent, to some extent at least upon the diet that has preceded it If the diet has been adequate until this time, and disease has not taken its toll, the adult reaches the half century mark with a feeling of being still young, in fact, in the prime of life From then on, however, he will be more content to watch the game than to play actively His activities are gradually and unconsciously curtailed, his movements are slower and more deliberate and he seeks a life of ease and comfort Appetite is probably still keen and food is thoroughly enjoyed, but there is need for a decrease of intake to compensate for the change in activity And as age increases, there is a gradual checking of life's fire as glandular activity slowly decreases This is added reason for decreased food intake On the basis of weight in fact the caloric requirement is approximately one half that of a 2 year old child According to the older ideas of body protein being static it was assumed that the protein requirement was definitely less since growth was no longer a factor Today, however the theory of a constant breakdown and resynthesis of body protein is generally accepted, thus the protein level should remain around 1 gm per kilogram—certainly not less than 0 75 gm per kilogram

The Recommended Dietary Allowances of calories for the adult have been calculated on the basis of a reduction of approximately 5% for each decade after age 25 For ages through 24

an upward correction of 0.5% per year may be made. This is for the reference man or woman of 65 and 55 kilograms (143 and 121 pounds). Adjustments need to be made when the individual differs in body build from the reference man or woman. Formulas for such adjustment may be found in the N.R.C. publication No. 302, *Recommended Dietary Allowances—Revised, 1953*.

It is important to recognize that the decrease in caloric need will vary with individuals. However, there are two primary factors which influence the caloric requirement. It is known that there is a decrease in basal metabolism with increasing years. Keys has suggested that there is a reduction in the basal metabolism of 5% for each decade beyond 30 years. Others have indicated that the decrease corresponds roughly to a 10% reduction between 60 and 70 years, a 20% between 70 and 80, and a 30% fall over 80. A second factor related to the decrease in calories is lessened physical activity. As an individual grows older he tends to decrease his participation in sports, to work less vigorously, and to undertake fewer and fewer outside activities that require significant amounts of energy. As indicated above, the extent to which calories are lowered will vary with the individual and be governed by his body build, his basal metabolic rate, and his physical activity.

It has been suggested by many that the reduction in calories from the normal diet be in fats and carbohydrates. The role of dietary fat in the deposition of cholesterol is still open to question (see Chapter 39) and fat is known to retard digestion (see Chapter 6). Also, many fats cause gastrointestinal discomfort. Carbohydrate foods frequently provide only calories. It is wiser for the individual to choose those foods that contain minerals and vitamins as well as carbohydrate.

Animal studies indicate that high quality protein is important in maintaining health in the older person. Negative nitrogen balances have been found in studies with the geriatric individual. Diet surveys have shown that these people frequently have intakes that are low in protein. They often dislike milk, have difficulty eating meats because of poor teeth, and will resort to bland foods of high carbohydrate value but which contain little protein. It is generally accepted that reduced gastric hydrochloric acid is to be expected in the older persons. Walker raises

the question whether the protein deficiencies seen are due solely *to low intake or to a combination of low intake plus incomplete* digestion and assimilation

The protein needs of the adult, whether 25, 45, or 65 and over, are believed to be based *on the formula of 1 gm of protein per* kilogram of body weight In some cases it has been necessary to give 1 0 to 2 0 gm per kilogram to obtain a positive nitrogen balance However, *Kountz and his fellow workers found that* their willing and cooperative subjects could not tolerate more than 1 0 to 1 5 gm of protein per kilogram over a prolonged period

Vitamins and minerals are frequently inadequate in the diets of older persons Studies of groups of subjects have shown multiple vitamin deficiencies, manifestations of vitamin A and niacin deficiency In one study, patients who had *lesions and* other signs characteristic of vitamin A deficiency were observed during a prolonged period during which they had access to a *diet providing 10,000 I U of vitamin A daily* However, a significant reduction of these conditions occurred after four to ten months of treatment with 30 000 I U *of* vitamin A preparation It was suggested that perhaps the development of these conditions, even though the diet was so adequate in vitamin A, was associated with the low gastric acidity and poor fat absorption so frequently seen in older adults

The thiamine and niacin level in the recommended *allowance* for the adult decreases with the decrease in calories The present ratio is 0 5 mg of thiamine per 1,000 calories for energy needs *of less than 3,000 calories* When the intake is below 2 000 calories the thiamine allowance is not less than 1 mg daily The recommended allowances for niacin are ten times the thiamine allowances, and, therefore, decrease correspondingly

Calcium and iron are of great importance in the nutrition of the geriatric individual Not only do many older people limit their intake of milk the best source of calcium, but it also has been suggested that gastric anacidity results *in poor absorption* of calcium and phosphorus

Stieglitz and many others have emphasized the importance of water *in the diets of older persons* Water functions as a carrier of nutrients and waste products and, if the individual drinks an

adequate amount of fluid it may also help in the control of constipation a condition which is frequently found in older adults

In many cases it is wise to limit the indigestible fiber to soft cooked foods rather than to include raw or cooked fibrous foods such as celery raw carrots and sweet corn Some authorities recommend that no condiments or spices be included in the diet that is those that are so strong that they burn the tongue Some people have found it advantageous to limit their consumption of coffee and tea

The salivary glands may be sluggish the gastric juice have a decreased HCl and the other digestive juices may be decreased in amount hence seemingly harmless foods may sometimes produce indigestion Frequently there are physical changes in the gastrointestinal tract—lack of teeth improperly fitting dentures decreased motility atrophy etc Absorptive ability is usually decreased Kidney function may be impaired Diarrhea and constipation are common complaints Anemia is a common finding These are factors which influence dietary planning

To change the eating habits of those of advanced years presents a challenge Ideally it is hoped that the young adult of today and those of the so called middle years will come to the geriatric period with food habits well directed toward good nutrition However the older person today must learn the value of good nutrition and to realize that food is as important in old age as at any other time of life The idea that for elderly people food is of little concern is no longer acceptable It must be remembered that as one grows older and his outside activity decreases eating may assume a very important role in the life pattern Even as the geriatric individual may seem indifferent to food his very lack of concern expresses an attitude which needs to be recognized and redirected

Donahue emphasized the importance of paying attention to environmental factors that have psychological influence in feeding older people Examples of practices which take these factors into account were enumerated by Donahue (a) serving attractively arranged trays (if the individual is bedridden) (b) giving special decor to the institutionalized table (c) serving extra quality out of season or specially prepared foods (d) changing food flavors or food types (which is especially important in institutional settings where variety of cooking style is at

best limited), (e) using food colors in attractive combinations, (f) eliminating foods which are embarrassing for the individual "sans dents" to masticate in the presence of others, (g) avoiding foods against which the individual may have developed a phobia, and (h) giving special attention in the form of an occasional favorite dish prepared from a cherished recipe" The effects of the environment and of the various meanings that food may hold for individuals (see Chapter 1) must not be overlooked in this age group

Dr C Ward Compton contends that man has seven ages chronological (age in years), anatomical (stage of growth and change in cells, tissue, and organs), physiological (how effectively and normally the organs function), psychological (mental alertness and attitude), and, last, the pathological age which refers to the changes brought about by disease

One should be able, to at least some extent, to control his aging through medical care, proper diet, correct health habits, and a philosophical and tolerant outlook on life

In summary, then, the diet of the young adult and the adult in *his middle years should receive attention*, as well as the food of the older person The logical diet of the geriatric individual is one of adequate protein, decreased fat, and enough carbohydrate to yield sufficient calories to meet the specific need The meals should be simple, relatively low in indigestible fiber, and should be devoid *of highly seasoned and gas forming foods* Six small meals are preferable to three hearty ones In addition, adequate rest, relaxation, occupation, and *"fun" must be considered as* part of his health program

As Piersol and Bortz suggest, ' Add life to years rather than years to life " To combat the ills which normally accompany advancing age good nutrition is important The age of tea and toast is past

Review Questions

1 At what time does the aging process begin?
2 How well fed is the adult population in the United States today?
3 What are some of the problems that are prevalent among the adult population today?
4 How does the diet differ in old age from other periods? What are some of the physiological reasons for such changes?

5 How and why have our ideas changed in the care and treatment o elderly people?
6 What is the name given to the branch of medicine which deals wit this group?

Suggested Projects

1 Interview an individual over 65 years of age Obtain a diet histor from him (See Table 70) Evaluate the nutritional content of th diet Find out the likes and dislikes of this patient, if he cannot ea certain foods, and why he may omit them from his diet Discuss hi reaction to the environment of his meal service Do you have an suggestions to help him?
2 Conduct the same type of investigation for several adults such as working girl a homemaker, a businessman

in preference to the dark fish, such as tuna, salmon, mackerel, and sardines The latter contain large quantities of fat If used at all, boiling water should be poured over the broken pieces until the oil is completely removed

6 Eggs—three or four each week, 1 per day is preferable—in any way except fried

7 Cheese—generous amounts of cottage cheese All other kinds should be omitted from the diet The cottage cheese may be variously flavored by the addition of chopped chives, pickles, onions, tomato or pineapple juice, green peppers, etc

8 Fats in very small amounts, approximately 3 to 4 teaspoonfuls daily These may be butter, margarine, oil or cream Other fats, such as meat drippings, should be omitted

Clear soup, bouillon, or beef tea, tea and coffee may be used as desired They have no food value Likewise "diabetic" gelatin is palatable and an excellent filler

Oil salad dressing, candy, pies, cakes, cookies, corn, peanut butter, nuts, jellies, jams, fat meats, Lima beans, fried foods, spaghetti, macaroni, crackers, dried peas, beans, or lentils potato should be avoided, as should foods usually consumed as between meal snacks

The way in which these foods are adapted depends upon the individual food pattern Many factors have to be considered (see Chapter 26), such as economic resources, cultural patterns and environmental conditions under which the individual lives The diet must satisfy (have satiety value) and it must not make the dieter either unduly conspicuous or self conscious And, last, in most instances the diet must be such that the individual will be maintained in a state of health and strength compatible with his normal occupational activity

There are many combinations in which these foods may be used Some of the milk and egg may be made into custard, or the breakfast cereal may be omitted and rice or tapioca pudding prepared Celery, watercress chives, radish, and peppers used as garnish need not be counted

The day's bread may be used in a sandwich with meat cottage cheese, lettuce, cabbage, etc if the noon meal is the lighter meal

Four very thin slices of home cut bread will equal two slices of ready sliced bread. It seems like more bread. Made into Melba toast, the need for butter is obviated due to the altered flavor.

When a lower calorie intake is desired, the following diet outline may be used, but *only when medical supervision is available*:

750 calorie level: 1½ pints of skim milk, 2-3 cups of 5% vegetable, 2 ounces of meat, 1 egg, 3 oranges, ½ cup of cottage cheese.

1,000 calorie level: The above diet and in addition—1 small serving of cereal, ½ cup 10% vegetable, 1 piece of sliced bread, 1 ounce of meat or fish.

Or one may prefer to: Gradually use smaller sized portions of food. Change to the diet as outlined at once and then gradually decrease the size of the serving until the amount indicated is reached. It may be more satisfactory to do this slowly and faithfully than to make a sudden change by decreasing the diet to the point of extreme hunger.

For an individual whose calorie requirement is 2,000, a reduction below 750 calories should never be undertaken, and even this low level only when drastic reduction is imperative. In general it is distinctly unsafe to reduce calorie intake to a point below one half the required calories, because such adjustment of food essentials is extremely difficult. To repeat, *reduction should be medically supervised*.

At levels of 1,200 calories or less, commercial vitamins must be administered to prevent deficiencies in the vitamin B group and the fat soluble vitamins.

Recently a study of Ohlson, which was duplicated by Young, indicated that a diet containing a higher percentage of the total calories in fat than has been practiced formerly seems to give great satisfaction to the reducer. The patients who participated in these studies said that they were not hungry between meals, they felt well, and they were satisfied with their diets.

Exercise in order to maintain or re-establish normal muscle tone is important, not strenuous exercise but well planned exercises and exercise. It is said that the difference between a good

figure and a lumpy one is the muscular development Fat loss must be replaced by well toned muscles for organ support Sudden withdrawal of fat pads is dangerous

It has been calculated that from the first to the one hundred third floor of the Empire State Building there are 2 240 steps, to climb this would require 2,000 calories, which would correspond to about ½ pound body fat To lay 14,731 bricks would cost 4,000 calories Obviously, exercise alone is a foolish attempt at weight loss aside from the fact that strenuous exercise is usually accompanied by an increase in appetite The sudden weight loss in violent exercise is due largely to water

TABLE 64

THE NIBBLE	APPROXIMATE MILEAGE TO "WALK IT OFF"
1 caramel	0 7
1 inch cube of chocolate fudge	1 3
1 jelly bean (who can stop with one?)	0 1
1½ ounces milk chocolate (a 5 cent bar)	3 3
1 graham cracker	0 7
1 cup ginger ale or other soft drink	1 2 2
1 cup beer	1 2 2
1 ice cream cone (5 cents)	1 5 1 7
1 ice cream sundae	5 7
1 doughnut	2 8
1 salted peanut	0 1
1 date	0 3 0 5
1 cup popcorn (without butter, though you probably don't eat it that way)	1 0
1 tablespoon butter (a very modest allowance for the popcorn)	1 5
1 sliced ham sandwich	2 5 3 5
1 piece mince pie (4½ inches at circumference)	6 5
1 piece chocolate loaf cake (3 × 3 × 2 3 inches)	1 5

In *The Cornell Bulletin* on "How to Control Your Weight" Dr Hazel Hauck includes a table to indicate the energy value of some common snacks in terms of the miles needed to be walked in order to use up the energy which they provide (Table 64)

It is difficult to find the time to participate in enough exercise to appreciably bring about a caloric deficit of several hundred calories which can easily be *accomplished through diet restriction* However there are many opportunities whereby the dieter can expend extra calories, such as walking a few blocks instead of taking a bus or driving the same distance Energy expendi

ture even though it might be of short duration yet, if constant can add to the caloric deficit and thereby contribute to subsequent weight loss

Drugs are frequently used these last several years as a means of appetite curtailment In some instances under a physician's direction these may be justified They may have an unwanted effect on blood elevation and *should never be self prescribed* The use of thyroid without supervision is also dangerous

In those individuals whose metabolic rate is lower than most the addition of a thyroid preparation to counteract the glandular condition will usually result in satisfactory increase in metabolic rate and corresponding weight reduction The activity of the thyroid gland can readily be ascertained through determination of the basal metabolic rate (see Metabolism Chapter 8) Roughly each grain of thyroid (U S P) will increase the basal metabolic rate by 10% *Thyroid and other drugs should be taken only when adequate medical supervision is available* Unfortunately many so called obesity cures on the market today contain such drugs and their use should be avoided Also available are vitamin mineral pills with accompanying instructions which are planned to produce a low calorie diet—these without the famed product would bring about weight loss if instructions were faithfully followed

Thus the present belief is that a caloric deficit must occur in order to bring about weight loss in the obese This may be done through a reduction in energy intake an increase in energy expenditure or a combination of both When a low calorie diet is planned care must be exercised to follow the usual eating habits of the overweight individual as much as possible The patient must be convinced that weight loss is necessary and that a modification of his food pattern now and in the future will be effective in reducing and staying reduced Without complete cooperation on the part of the patient he may not maintain his weight loss Recently investigations have studied the effect of a group of overweight individuals trying to lose weight together under the guidance of a physician a nutritionist a psychiatrist or some other qualified group leader Though these are pilot studies the evidence suggests that group discussion may be an effective method in the treatment of

obesity However, since most, if not practically all, overweight can be prevented, today educational programs by medical centers, private physicians, schools, health departments, and life insurance companies are directed toward convincing the general public that it is to the advantage of all not to become overweight For the most part, the public is made aware that it is possible to keep from gaining weight If weight gain does occur it is not inevitable with advancing years Rather, it is a symptom which should immediately direct the individual toward medical help

The Underweight Individual

On the opposite side of the picture from the obese individual is the malnourished or underweight person, who, due to dietary habits, activity, hyperglandular secretion, chronic illness acute illness, or abnormality in food utilization (see Table 73), is below normal weight for his height and age In many of these cases diet adjustment requires even greater ingenuity than for the obese person Protein and caloric intake must be liberal and must exceed the daily needs in order that depleted stores may be restocked

Fats in the form of cream, egg yolk, salad dressing, cream cheese, etc, are concentrated foods and excellent "padding" However, excessive amounts may have the reverse effect through the prolongation of the time of digestion and the resultant decrease in appetite (see Chapter VIII)

Milk may be padded with powdered whole milk, skim, or malted milk in such a manner as to double or triple its concentration Many flavors are available, which prevents monotony Such preparations as Cal C Tose, Betene, Ovaltine, Meritene etc serve the purpose of adding extra food value and variety Gelatin may be dissolved in fruit juices if drunk immediately Eggs may be concealed in a variety of foods

Cereals, starchy vegetables and breadstuffs are concentrated carbohydrates and are excellent carriers of fats (butter, cream peanut butter)

If weight is to be increased, the caloric intake must contain from 25 to 50% more calories than the normal requirement of the individual As in weight reduction, a gradual increase may be much more effective than a sudden change in dietary habits

TABLE 65

MENUS ADAPTED FOR WEIGHT GAIN AND WEIGHT LOSS

WEIGHT GAIN	Calories	WEIGHT LOSS	Calories
	Breakfast		
Orange juice	50	Orange juice	50
2 eggs scrambled	212	Poached egg	77
2 slices toast	110	1 slice toast	55
3 tsp butter	150	1 tsp butter	50
Coffee		Coffee, black	—
2 Tbsp heavy cream	90		
2 tsp sugar	32		
	644		232
	Lunch		
Sandwich		Sandwich	
2 slices bread	110	2 slices bread	110
3 tsp mayonnaise	92	1 tsp mayonnaise	30
1 oz tuna fish	56	1 oz lean beef	88
lettuce leaf	—	lettuce leaf	—
carrot slices	21	Carrot sticks	21
Layer cake	322	Apple (medium)	76
1 glass whole milk	166	1 glass skim milk	87
	767		412
	Snack		
Danish pastry	195	Coffee, black	—
Coffee			
2 Tbsp heavy cream	90		
2 tsp sugar	32		
	317		
	Dinner		
Clear soup	9	Clear soup	9
3 crackers—butter	170	3 oz lean pot roast	197
6 oz lean pot roast	394	½ cup peas	55
½ cup mashed potatoes	120	Chef's salad	10
butter—gravy	75	vinegar tomato dressing	2
½ cup peas—butter	100	½ grapefruit	75
Chef's salad	10	Coffee, black	—
French dressing	59		
½ grapefruit	75		
Coffee			
2 Tbsp heavy cream	90		
2 tsp sugar	32		
	1,134		348
	Evening Snack		
1 glass whole milk	166	1 glass skim milk	87
Sandwich		2 saltines	34
2 slices bread	110	½ oz cheese	40
1 oz toasted cheese	105		
2 tsp butter	100		
	481		161
Total calories	3,343		1,153

Malnutrition may be a dominant factor in many diseases and may be a matter of grave importance The physical surroundings, attractiveness and palatability of the food, and the mental attitude of the patient usually require special consideration (see Fig 2) Small and more frequent feedings may be desirable (see Chapter 27)

It is possible to plan two diets which, to the casual eye, would be nearly identical as to ingredients and quantity However twice as many calories may be included in one of them The difference lies only in the concentration of the foods themselves Using the outline for the normal diet, the underweight and the overweight could be served the meals suggested in Table 65 Both would be satisfied and neither would be conscious of caloric adjustment and, with that psychological factor eliminated, the diet would be more easily followed A diet which gives a feeling of hunger or of fullness or which psychologically is not satisfying will not be followed willingly

Frequently small between meal "snacks" of fruit, fruit juice milk or milk drinks is of distinct value in a weight gaining regimen Its effect on the next meal, however, must be considered, also the practicability of obtaining the extra meals In some cases a bedtime meal can add several hundred calories to the day's intake without affecting the appetite

As such dietary adjustments are made, it must be remembered that activity plays a large part in determining the caloric need Due consideration must be given to this element, and an attempt must be made to have the activities supplement the caloric change rather than counteract it

Review Questions

1 What are the factors that may influence a gain in weight?
2 Why is it undesirable to be above ideal weight?
3 What is the difference between obesity and overweight?
4 How may obesity and overweight be determined?
5 What is the difference between tables of average weights and tables of desirable weights?
6 How may the loss of weight per week be predicted?
7 What are the principles of a low caloric diet?
8 What foods may be eaten by the underweight individual which are forbidden for the obese?
9 What are the principles in planning a diet for the underweight individual?

Suggested Projects

1 Examine your own menus Calculate the total caloric content Is it above or below that recommended for your age group in Table 3?
2 Determine your caloric expenditure, using the food nomogram in Chapter 8 Is your expenditure approximately the same as your energy intake? If not, is the change in energy balance reflected in your weight?
3 Using your own diet as a pattern, plan a 1200 calorie diet for yourself Is it a diet that you would adhere to? What foods would you have to do without that you particularly like? What difficulties would you encounter in following the diet?
4 Plan a diet for a homemaker who is the only one in the family that needs to lose weight How can her meals be adjusted from those of the rest of the family? Will she have any difficulty in following her diet?
5 Plan a weight loss regimen for a teen age girl Be sure to include foods for after school and all the social occasions in which she will want to participate How many calories do you need to include in order to meet the nutritive needs of a teen ager?
6 Plan a weight loss diet for a man who eats his lunch in a restaurant Most of these luncheons are business appointments and he eats accordingly How may these meals fit into his reducing program? What will be his problems in following the diet?
7 Plan a weight gaining program for a teen age boy Be sure to plan for foods that he will want to include in his diet What is the per cent above his caloric expenditure that you have planned to include? What difficulties do you think he will encounter in following the diet? What will be the relative expense of this diet regimen?

CHAPTER 23

FOOD CUSTOM AND CULTURE PATTERNS

The American people come from all parts of the world and this variation in origin is reflected in our food patterns In America, there are many who are foreign born who brought food customs from their native lands with them to this country There are others born here who still adhere to the foods of their parents Some may retain certain favorite dishes while accepting newer ones which they have learned here Still others may be the children of marriages between two different cultures and their food patterns indicate a blending of many patterns Whatever the source for the food pattern, it is necessary to have some understanding of its origin and to appreciate the nutritive value Food patterns cannot be modified, either for improved nutrition or for therapeutic diets, unless such insight is incorporated in teaching

As indicated in Chapter 1, food preferences are obtained primarily from the home There is wide variation in the foods used within any one country and, frequently, among families So, it is impossible to attribute certain foods as always occurring in the menus of a country or of a family from that country

There are three primary factors which may affect the native food patterns, geographic, economic, and religious Of course, there are many other influences which might be enumerated, but few have such far reaching effect as those designated above.

Obviously the *location* of a country will affect its food pattern If there are large coastal areas or many inland lakes, fish may be a staple of the diet If the climate is such that there are many varieties and plentiful amounts of fruits, these will be found in the daily diet Similarly, if the country is mountainous, the people of that region usually eat food that is raised there The degree of development of transportation within a country itself affects the food pattern For example, if there is very little communication and transportation within a country there is likely to be small exchange of commodities from the coastal areas to the inland regions Here in America many food patterns are

typical of a specific section, such as New England, the West Coast, the Midwest, and so on. This is a reflection of the days when there was little commerce from region to region.

A second major factor that influences the food pattern may be designated as *economic*. The family income is reflected in the kinds of foods that are on the table. The farm family usually produces much, if not most, of its food, while those who reside in urban areas must purchase food that is within a budget. In many farm families, in America as well as in other countries, it is the custom for the women to work outside along with the men; hence, such patterns as second breakfasts and one-dish main meals which could be cooking while all worked originated. Frequently, a pattern was established while a family or a region was in certain financial circumstances. Then, although they have become more affluent, they may still adhere to the pattern which is typical of their former financial status. However, it must be kept in mind the amount of money spent for food does not necessarily reflect its nutritive value; a menu which is very expensive may be less nutritious than an inexpensive one.

Among the strongest influences upon food patterns are the customs associated with *religion*. Many beliefs are well known. The Moslems cannot eat pork. Catholics cannot eat meat on Fridays and other religious holidays, and some sects practice vegetarianism.

The Jewish religion has many dietary laws which determine food patterns. Generally speaking, the Jewish people adopt the food customs of the country in which they live and adapt these foods within the framework of the tenets of their religion.

Only the forequarters of animals that chew the cud and have cleft hoofs are permitted. All meat must be killed in a prescribed manner (see below) after which it is called kosher meat. Fish with fins and scales are allowed. There are three groups of foods: meat and poultry; milk and its products; and neutral foods such as fish, eggs, cereals, fruits, and vegetables. The neutral foods may be served with each of the first two groups but milk and its products may never be served with meat or poultry. Bread that is eaten at the meat meal contains no milk or butter and bread that is eaten with the milk meal must contain no animal fat. Frequently a neutral bread is made which may be used with either group.

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TAB

FOOD CUSTOMS AND CULTURE PATTERN

I LEAFY, GREEN AND YELLOW VEGETABLES	II CITRUS FRUITS, TOMATOES, RAW CABBAGE	III POTATOES, AND OTHER VEGETABLES, FRUITS	IV MILK, CHEESE, ICE CREAM	V MEAT, POULTRY, FISH, EGGS
		Italian		
Broccoli Dandelions Fennel Green peppers Escarole Spinach	Tomatoes (large amounts as sauce)	Egg plants Zucchini squash Potatoes (occasionally) Fruits in season Legumes Lentils Kidney beans Chick peas Dried split peas	Milk (less used here) *Milk* Cheese	Beef Lamb Organ meats Highly seasoned meats (salami, sausage, etc) Fish (occasionally) Eggs (fried)
		Near East: Armenia, Greece, Syria, Turkey		
Broccoli Dandelions Peppers	Tomatoes	Cucumbers, Egg plant, Leeks, Okra, Onions } frequently Potatoes (seldom) Dried Apricots, Raisins, Figs, Dates } frequently *Melons* (summer) Fruit compotes Dried beans Peas, lentils Nuts (occasionally)	*Fermented milk* *Sour cream* **Pasteurized milk (particularly children)**	Lamb Chicken Eggs Fish, *fresh, salted, smoked*

Foods unless otherwise designated are used in both the native country and the United States
Italics indicates foods used primarily in the native country
Black type indicates food adopted after coming to the United States

Kosher meat, meat from an animal that is killed by a special official in a manner which drains as much blood from the animal as possible, is sold only at kosher markets It must not touch any prohibited foods. Usually meat is not considered kosher

ED TO THE BASIC SEVEN

VI AD, FLOUR ALS, WHOLE N ENRICHED	VII FATS, OILS, BUTTER	SWEETS MISCELLANEOUS	COMMENTS
		Italian	
n white l l products as macaroni, spaghetti *meal po* a (Northern s)	Olive oil **Butter** Salt pork	Cakes (holidays) Chestnuts **Sweets** **Candy** Garlic (flavoring)	1 Dislike American cheeses, prefer native varieties and may pay excessive prices for imported Italian cheeses 2 Green vegetables are well liked and served in large portions, variety as salads 3 Soups are frequently made with legumes 4 Seldom use cream, except in special desserts 5 Desserts seldom used, fruit frequently served as dessert
	Near East	*Armenia, Greece, Syria, Turkey*	
l, *cracked* *at, thin and* l, white r	Ripe olives (no butter) Lamb fat Seed oils Olive oils **Margarine**	Grapevine leaves (imported here) Many herbs and spices Honey **Sugar** Coffee thick sweetened	1 In native country, fermented milk and sour cream are used in combination with many foods soups, meats, vegetables with pastries and cottage cheese 2 Vegetables frequently fried, may be broiled or stuffed with cereal, or served as a one dish meal 3 Diet may be low in ascorbic acid content 4 Pattern frequently includes a hearty main dish 5 May substitute wilted cabbage leaves for grape vine leaves

(Continued on page 334)

after seventy two hours After the meat is purchased and in the home, it is further treated It is soaked in water one half hour, salted liberally, placed on a perforated board and then allowed to drain for one hour to remove as much of the remaining blood as possible If a patient who is an orthodox Jew is placed on a low sodium diet, it is necessary to consider the amount of

I LEAFY, GREEN AND YELLOW VEGETABLES	II CITRUS FRUITS, TOMATOES, RAW CABBAGE	III POTATOES, AND OTHER VEGETABLES, FRUITS	IV MILK, CHEESE, ICE CREAM	V MEAT, POULTR FISH, EGGS	T
		Czechoslovakian			
Spinach	Cabbage Tomatoes **Citrus fruit (small amounts)**	Legumes: Lentils Yellow split peas White navy beans Carrots Potatoes Beets Celeriac Kohlrabi Turnips Onions Dried fruits	Buttermilk Clabber Cottage cheese Sour cream *Milk, goat's or cow's* Milk (not as liberal as formerly)	Eggs Sausage Internal organs (lungs, heart, tripe, etc) Beef Pork Veal	
		Polish			
abbage roccoli een peppers le rel nach ng beans erkraut		Potatoes Beets Carrots Root vegetables Mushrooms Legumes (widely)	*Milk* *Sour cream* *Cheese* Cottage cheese	Beef Pork Veal Eggs (frequently) Fish, fresh salted, pickled Geese Duck Poultry Internal organs	
		Irish			
	Cabbage (frequently) **Tomatoes**	Potatoes } frequently Turnips }	Buttermilk (frequently) Cheese (small amounts)	Eggs (boi Bacon (fre quently) Mutton (oc sionally) Beef (seldo Fish, cod, ha dock (fre quently)	

61—CONT'D

VI BREAD, FLOUR CEREALS, WHOLE GRAIN, ENRICHED	VII FATS, OILS, BUTTER	SWEETS MISCELLANEOUS	COMMENTS
		Czechoslovakian	
Rice Barley Farina Cream of Wheat *Oatmeal* Pumpernickel Sour rye bread Dumplings (white flour)	Butter Bacon Goose fat	Honey **Candy** Seeds Spices Nuts **Sweetened carbonated beverages**	1 Milk used liberally in cooking, though not often used as a beverage and often not as freely here as in native country 2 Meals frequently consist of hearty one dish meals 3 Wide variety of vegetables used 4 Wide variety of cereals used in many interesting combinations
		Polish	
Oatmeal **Cornflakes** Dark rye bread **White bread (children)** Buckwheat Oats Rice	Butter (moderately) Lard Bacon fat Poultry fat Suet Oils Flax Hemp Sunflower **Salad oils**	Pastry (on special occasions) Desserts (seldom) **Candy (liberal)** **Sugar (liberal)** Honey Jam Dill Saffron Mace	1 Milk and sour cream used less widely in United States than in native country, often used in soup 2 Milk given to children, adults prefer cheese 3 Vegetables cooked for long time, principally in soup or boiled and served with hot milk 4 Eggs may be fried or boiled 5 Fish is usually used only on Fridays 6 One dish meals very popular 7 Inexpensive cuts of meat cleverly used
		Irish	
Oatmeal Indian meal porridge White baker's bread Rye, Oaten cake, Whole wheat bread } Occasionally home made	Butter (small amounts) Lard drippings (cooking)	Cake, Pie } frequently Tea with sugar (frequently) Sugar	1 Buttermilk used with potatoes and cereals 2 No cream used 3 Most vegetables are cooked in soup 4 Little fresh fruit used, some stewed fruit and sauces are used for dessert 5 Sugar is added freely to prepared foods

C1—Cont'd

VI BREAD, FLOUR, CEREALS, WHOLE GRAIN, ENRICHED	VII FATS, OILS, BUTTER	SWEETS, MISCELLANEOUS	COMMENTS
		Czechoslovakian	
Rice Barley Farina Cream of Wheat *Oatmeal* Pumpernickel Sour rye bread Dumplings (white flour)	Butter Bacon Goose fat	Honey **Candy** Seeds Spices Nuts **Sweetened carbonated beverages**	1 Milk used liberally in cooking, though not often used as a beverage and often not as freely here as in native country 2 Meals frequently consist of hearty one dish meals 3 Wide variety of vegetables used 4 Wide variety of cereals used in many interesting combinations
		Polish	
Oatmeal **Cornflakes** Dark rye bread **White bread (children)** Buckwheat Oats Rice	Butter (moderately) Lard Bacon fat Poultry fat Suet Oils Flax Hemp Sunflower **Salad oils**	Pastry (on special occasions) Desserts (seldom) **Candy (liberal)** **Sugar (liberal)** Honey Jam Dill Saffron Mace	1 Milk and sour cream used less widely in United States than in native country, often used in soup 2 Milk given to children adults prefer cheese 3 Vegetables cooked for long time principally in soup or boiled and served with hot milk 4 Eggs may be fried or boiled 5 Fish is usually used only on Fridays 6 One dish meals very popular 7 Inexpensive cuts of meat cleverly used
		Irish	
Oatmeal Indian meal porridge White baker's bread Rye, Oaten cake, Whole wheat bread — Occasionally home made	Butter (small amounts) Lard drippings (cooking)	Cake, Pie — frequently Tea with sugar (frequently) Sugar	1 Buttermilk used with potatoes and cereals 2 No cream used 3 Most vegetables are cooked in soup 4 Little fresh fruit used, some stewed fruit and sauces are used for dessert 5 Sugar is added freely to prepared foods

I LEAFY, GREEN AND YELLOW VEGETABLES	II CITRUS FRUITS, TOMATOES RAW CABBAGE	III POTATOES, AND OTHER VEGETABLES FRUITS	IV MILK CHEESE ICE CREAM	MEAT P FISH
		Puerto Rican		
Green peppers	Tomatoes Tomato puree	Plantin Chayote Cassava Malangas Yams Yautis Legumes Black beans Lima beans Navy beans Pinto beans Red beans Chick peas Okra Onions Bananas	*Cheese* (small amount) Milk (occasionally)	*Eggs* (sm amount) Fish Fish drie salted
		Mexican		
	Tomatoes (daily) Citrus fruits	Dried beans Chili peppers Bananas Onions Cabbage Turnips	Milk (small amounts)	Beef } fr Chicken } qu Pork Lamb Fish
		Portuguese		
Kale	Cabbage	Green beans *Fruit* Fruit (seldom)	Milk (seldom) *Cheese* (on bread)	Fish (frequently) Sausage (frequently in so Beef } sel Pork } sausage } Veal } Eggs (occasionally)
		French Canadian		
	Cabbage (frequently) Apples (frequently) Green tomatoes pickled (frequently)	Turnips } principal Beets } Peas } Salt beans (winter)	Milk (small amounts) Cheese (seldom)	Salt fish (frequently) Pork (frequently) Beef (seldom)
		Chinese		
amboo shoots		Soybeans (frequently) Legumes Vegetables (native)	Milk (small amounts for children and infants) Cheese (seldom)	Eggs } small Fish } amoun Meat } Poultry }

6 (CONT'D)

VI BREAD, FLOUR, CEREALS, WHOLE GRAIN, ENRICHED	VII FATS, OILS, BUTTER	SWEETS, MISCELLANEOUS	COMMENTS
		Puerto Rican	
Rice	Lard Salt pork Ham fat	Annato (coloring matter) Garlic Coffee (every meal) Molasses Olive oil	1 Stew is a common dish 2 Usually buy foods from meal to meal 3 If cannot find native foods in local markets normally may not experiment with substitutions or new foods
		Mexican	
Corn meal (tortilla) Wheat (milled) Noodles (occasionally)	Butter (seldom)	Sweet rolls Sugar Coffee	1 One chief meal eaten daily usually at noon 2 Meat usually served as a stew
		Portuguese	
Corn products Bread (white flour corn meal)	Lard	Sweets limited)	1 Cereals other than corn omitted in native land 2 Vegetables served in soups after long cooking 3 Fresh fruit seldom used here 4 Meat usually used as a flavor
		French Canadian	
Oatmeal White bread (made with water) Corn bread	Lard Butter (occasionally) Cream (frequently)	Pastry } frequently Cake }	1 Vegetables are often cooked too long a time in soups
		Chinese	
Rice (South China) *Wheat* (North China) Rice Wheat	Sesame oil Lard		1 Wide variety of native vegetables included in daily menus 2 Soybean curd widely used supplies calcium to the diet

sodium obtained from the koshered meat Meat may have to be omitted from the menu, however, the alternative dairy foods is often fairly high in sodium (See Chapter 39)

Foods prohibited are pork and its products, bacon, ham, and lard, blood in any form, so an egg with a clot would be discarded Suet of oxen, sheep, and goats is not used, nor is the hind quarters of any animal All shell fish are not allowed Milk or milk products may not be served from three to six hours after a meal at which meat was served Cooking is prohibited on the Jewish Sabbath Special foods are associated with religious holidays, the observance of Passover lasting eight days On some religious days, no food is eaten In order to maintain full separation of meat foods from dairy foods, two complete sets of dishes are used in addition to a special set for Passover However, glass dishes may be used for both meat meals and dairy meals

Table 66 is included to suggest some of the food custom and culture patterns which may be found in the diet of many Americans No one individual will adhere to the rigid pattern represented As indicated earlier, there is usually a blending of new patterns with the old when coming to the United States Table 66 in many cases, indicates customs that were practiced in the native country, foods obtained in both the native and adopted land, and foods which have been included after coming to the United States

It must be kept in mind that frequently a newcomer will do without many necessary things in order to buy familiar yet expensive imported food Or, if native foods are unobtainable he will do without Sometimes changes are made, such as substituting white flour for whole wheat, which are not as nutritious as the native food pattern Apart from including comments about the food customs, Table 66 has listed foods in the Basic Seven groups This may facilitate an evaluation of the diet However many other foods may be included in the patient's menu which are not shown here which may contribute to the total nutritive value

CHAPTER 24

A REVIEW CHAPTER ON THE ESSENTIALS OF AN ADEQUATE DIET

Many years ago Carl Voit defined food as a "palatable mixture of foodstuffs which is capable of maintaining the body in an equilibrium of substance or capable of bringing it to a desired condition of substance." The ideal food he further stated "is a palatable mixture of foodstuff arranged together in such proportion as to burden the organism with a minimum of labor." An analysis of that definition indicates the completeness of his understanding.

Food to be utilized most efficiently must be palatable and it must be eaten with enjoyment. It must be attractive in appearance and it must satisfy. In order to have adequacy there must be a mixture of foodstuffs in total readily utilizable from the standpoint of digestion. The amounts and properties of the foodstuffs in the mixture must be such that balance may be maintained between intake of necessary nutrients and outgo of waste products. *That such equilibrium is essential is demonstrated by* feeding experiments in which one or more dietary essentials are inadequate or lacking and study of the profound effects which follow restricted diets. Such experiments clearly indicate the potential dangers of our frequently lax food habits. McLester in a discussion of the normal diet expressed the idea that *man's place in future history will depend in no small degree upon the food which he eats.* McLester is by no means alone in this belief; therefore the first consideration in diet construction should be to keep the individual in a state of good nutrition or to bring him to this condition for his own sake and for the sake of posterity.

When a diet is to be taken for only a short time, such as three or four days, the nutritive balance is of relatively small importance; but when it must extend over a long period it must be adequate if deficiency diseases or their subclinical symptoms are to be prevented. Preventive medicine will eventually begin with diet adjustment. Malnutrition, whether its source be lowered caloric intake, specific shortage of any one food, or imbalance between food constituents, always results in decreased efficiency

TABLE 67

FOOD AND NUTRITION BOARD, NATIONAL RESEARCH COUNCIL, RECOMMENDED DAILY DIETARY ALLOWANCES,* REVISED 1953
DESIGNED FOR THE MAINTENANCE OF GOOD NUTRITION OF HEALTHY PERSONS IN THE UNITED STATES
(Allowances are Considered to Apply to Persons Normally Vigorous and Living in Temperate Climate)

	AGE YR	WEIGHT KG	(LB)	HEIGHT CM	(IN)	CALORIES	PROTEIN GM	CALCIUM GM	IRON MG	VITAMIN A I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG	VITAMIN D I U
Men	25	65	(143)	170	(67)	3,200†	65	0 8	12	5,000	1 6	1 6	16	75	
	45	65	(143)	170	(67)	2,900	65	0 8	12	5,000	1 5	1 6	15	75	
	65	65	(143)	170	(67)	2,600	65	0 8	12	5,000	1 3	1 6	13	75	
Women	25	55	(121)	157	(62)	2,300†	55	0 8	12	5,000	1 2	1 4	12	70	
	45	55	(121)	157	(62)	2,100	55	0 8	12	5,000	1 1	1 4	11	70	
	65	55	(121)	157	(62)	1,800	55	0 8	12	5,000	1 0	1 4	10	70	
	Pregnant (3rd trimester)					Add 400	80	1 5	15	6,000	1 5	2 0	15	100	400
	Lactating (850 ml daily)					Add 1,000	100	2 0	15	8,000	1 5	2 5	15	150	400
Infants‡	0 1/12§	6	(13)	60	(24)	kg × 120	kg × 3 5‡	0 6	6	1,500	0 3	0 4	3	30	400
	1/12 3/12	9	(20)	70	(28)	kg × 110	kg × 3 5‡	0 8	6	1,500	0 4	0 7	4	30	400
	4/12 9/12	10	(22)	75	(30)	kg × 100	kg × 3 5‡	1 0	6	1,500	0 5	0 9	5	30	400
	10/12 1														
Children	1 3	12	(27)	87	(34)	1,200	40	1 0	7	2,000	0 6	1 0	6	35	400
	4 6	18	(40)	109	(43)	1,600	50	1 0	8	2,500	0 8	1 2	8	50	400
	7 9	27	(59)	129	(51)	2,000	60	1 0	10	3,500	1 0	1 5	10	60	400
Boys	10 12	35	(78)	144	(57)	2,500	70	1 2	12	4,500	1 3	1 8	13	75	400
	13 15	49	(108)	163	(64)	3,200	85	1 4	15	5,000	1 6	2 1	16	90	400
	16 20	63	(139)	175	(69)	3,800	100	1 4	15	5,000	1 9	2 5	19	100	400
Girls	10 12	36	(79)	144	(57)	2,300	70	1 2	12	4,500	1 2	1 8	12	75	400
	13 15	49	(108)	160	(63)	2,500	80	1 3	15	5,000	1 3	2 0	13	80	400
	16 20	54	(120)	162	(64)	2 400	75	1 3	15	5,000	1 2	1 9	12	80	400

*In planning practical dietaries the recommended allowances can be attained with a variety of common foods which will also provide other nutrient requirements less well known the allowance levels are considered to cover individual variations among normal persons as they live in the United States subjected to ordinary environmental stresses common thereto

†These calorie recommendations apply to the degree of activity for the reference man and woman For the urban white collar worker they are probably excessive In any case the calorie allowance must be adjusted to the actual needs of the individual as required to achieve and maintain his desirable weight

‡The recommendations for infants pertain to nutrients derived primarily from cow s milk There should be no question that human milk is a desirable source of nutrients for infants although intakes may not provide the recommended levels of certain nutrients

§During the first month of life desirable allowances for many nutrients are dependent upon maturation of excretory and endocrine functions Therefore no specific recommendations are given

Sound structure cannot be built without building material, proper in kind and in amount. Man can accommodate himself to inadequate intake for a certain length of time but eventually he will suffer if it is continued too long.

To simplify planning of the normal diet specific points should be remembered. These are included in the Recommended Daily Dietary Allowances (1953 revision) (Table 67).

TABLE 67A

The data here summarized from earlier chapters may be used for approximate numerical calculation as follows

A man 6 feet tall — 72 inches
40 cal/inch
2880 calories

Roughly 3000 calories

If division between food stuffs is 15 per cent protein, 35 per cent fat, 50 per cent carbohydrate the calculation would continue

3000 calories	3000 calories
15 per cent	35 per cent
4) 450.00 protein calories	9) 1050.00 fat calories
112 approx gm protein (each gm yields approx 4 cal)	117 approx gm fat (each gm yields approx 9 cal)

3000 calories
50 per cent

4 cal)

The diet prescription (℞) would then read

3000 calories, 112 gm P 117 gm F 375 gm C

It can be seen from these values that in the normal diet there is a *rough* ratio between the nutrients—approximately 1 gm P 1 gm F 3.5 gm C. These figures, if kept in mind, make it possible to discern whether a therapeutic diet is high or low in any of the constituents by reading the prescription. *Furthermore, and very roughly, one can remember that for the* adult man the value is not far from 100 gm for protein—an easy whole number to remember.

The protein levels based on 3000 calorie intake are roughly as follows

7% protein calories	50 gm	protein—low level
10% protein calories	75 gm	protein—average level
15% protein calories	100 gm	protein—generous level
20% protein calories	150 gm	protein—high level
25% protein calories	200 gm	protein—very high level

I The calorie requirement

In the discussion of metabolism it is stated that calorie requirement varies with size, sex, occupation, and other factors. A

general average for a man doing moderate work is approximately 2,800 to 3,000 calories per day, and for a woman from 2,200 to 2,500. Weight loss or weight gain soon indicates need for increased or decreased calories (see Chapter 22, Weight Control). A simple calculation to *approximate* calorie requirement is to multiply the height of the individual in inches by 40 calories. Or, in the adult, it may be calculated as 35 to 40 calories for each kilogram of preferred weight (roughly, 25 calories under basal condition, 30 at bed rest, 35 at light exercise, 40 for moderate exercise, and 50 for severe activity). Supplying calories to meet the chosen weight naturally tends to bring the body to that weight.

II. The protein requirement.

Protein level is the second point in importance. High and low protein intake have both been advocated. An intake of protein well above the metabolic requirement, but below the extremely high levels, seems the most desirable. On the average present day diet the protein supplies from 10 to 15% of the total calories or approximately 1 gm. per kilogram of body weight at a 10% level, which is 70 gm. for the average man, and 1.5 gm. at a 15% level. It is wise never to permit the level of protein intake to fall below 0.7 gm. per kilogram, or a total of 50 gm. daily. If this occurs insufficient protein is supplied to meet the daily wear and tear of body tissues, the tissues themselves are burned, and protein deficiency occurs. Even when theoretically the lowest possible protein intake is desired, an intake below 0.7 gm. per kilogram may result in symptoms as harmful as those the diet was planned to alleviate. When a low level of protein is used, protein of high biological value (animal proteins, such as milk, cheese, eggs, meat, fish, and poultry) should be ingested. If the proteins of low biological value are substituted, a specific deficiency of one or more of the essential amino acids may result (see Chapter 5, Proteins).

With the higher protein intakes (as high as 2 to 4 gm. for a child) some protein of lower value (beans, peas, lentils, gelatin, etc.) can supplement the animal group.

One authority suggests a distribution of protein as follows: 19% milk, 28% meat, 18% eggs and cheese, 16% fruits and vegetables, and 19% from cereals—or one third from vegetable

sources and two thirds from animal sources However, an equal amount of animal and vegetable protein is a practical and safe proportion and is more economical if this is a factor

III The fat level

In the normal diet, fat supplies 25 to 45% of the total calories, 75 to 150 gm daily, or 1 to 2 gm per kilogram of body weight Since carbohydrate more effectively spares body protein than does fat, and since fat in too large amounts may not be well tolerated, a fat intake not to exceed 45% of the total calories is preferable to a higher intake, unless the higher intake is specifically indicated

The higher the fat, the more costly the diet When strict economy must be practiced the diet must necessarily be of high carbohydrate content

Changes in the quantity of fat in the diet may be a means of regulating appetite, since the higher the fat content of a meal the longer it stays in the stomach and the longer hunger pangs are deferred

IV The carbohydrate intake

Carbohydrate normally supplies roughly 40 to 50% of the total calories, from 4 to 5 gm per kilogram or a total of 300 to 400 gm Starches form the bulk of the carbohydrate eaten They are the cheapest source of energy and are neutral enough in flavor to be well adapted to liberal use The cereals, cereal products such as breads etc and the 15 to 20% vegetables are the chief sources of starch The fruits sugars and desserts supply the sugar

V The minerals

While no one mineral is of greater importance than another (see Minerals, Chapter 13), in general practice only three require calculation to assure adequate intake These are calcium phosphorus, and iron Sufficient protein in the diet insures sufficient sulfur Sodium and chlorine are provided in excess as seasonings The potassium content of vegetables is high But deficiencies of calcium, phosphorus and iron do occur Standard or optimum intake values which are sometimes suggested, include a margin of safety The optimum is the minimum requirement of these constituents plus 50%

For children the calcium and phosphorus should be 1 and 1.5 gm., respectively. Milk must be included for the phosphorus and calcium. All the calcium and half the phosphorus are supplied by three fourths quart of milk.

VI. The Vitamins

Even though the specific deficiency diseases seen in animals are rarely encountered in man, lowered resistance to infection and numerous vague clinical symptoms are known to be attributable to low vitamin intake. It is entirely possible to meet the normal vitamin requirement, with the exception of vitamin D, by means of food.

Vitamin A is abundantly supplied by cream, butter, cheese, milk, highly colored fruits and vegetables, liver, egg yolk, and salmon. If the diet contains a pint of milk, a serving of butter, a leafy or colored vegetable and fruit, a protein such as cheese, egg, liver, or a dark colored fish, the vitamin A requirement of the normal individual will be met.

Vitamin B. This group may, for simplicity, be considered together. Liver, whole grain cereals, milk, molasses, and yeast yield good amounts of vitamin B, while vegetables, fruits, and nuts are appreciable sources of all of this group. If the daily food contains a pint of milk, a whole grain, or enriched cereal, a serving of fruit, a leafy vegetable, and a serving of meat (particularly liver), the B group of vitamins will be supplied in adequate amounts.

Vitamin C is obtained in excellent amounts from the citrus fruits. An orange or half a grapefruit contains nearly enough to meet daily requirements. (The frozen and canned juices have essentially the same vitamin C value as the fresh fruit.) Cabbage, cauliflower, broccoli, strawberries, and raspberries are excellent sources, and most fresh vegetables and fruits are good sources. Raw vegetables should be used where practical. Salads are rich in vitamins.

Vitamin D is rather restricted as to natural sources. It is the one vitamin that requires supplementation by commercial products during the period of growth, especially when sunlight is not available. A fish oil should be considered as food in the diet of the child, not as medication.

The other vitamins of which we hear are still undergoing experiment and as yet need cause no concern. Physical ailments from their lack have not yet been proved. We may well assume that since they are closely associated with the familiar vitamins sufficient amounts of the one group will insure the presence of adequate amounts of the other.

Vitamin K deficiency occurs only when faulty absorption of fat exists or there is liver dysfunction of such nature that the vitamin is destroyed. If the diet contains an abundance of green leafy vegetables deficiency could result from such pathologic change only.

VII. Water

Water plays an important part in good nutrition. It is available to the body from three sources: ingested as such or as tea, coffee, fruit drinks and other beverages; as preformed water which is part of the composition of the food (milk is 87% water, fruits and green vegetables 75 to 90%, ready-to-serve cereals contain 10%); and last, the metabolic water which results in the oxidative breakdown of food (see Chapter 15, Water Balance). In general the intake of fluids as such should not fall below 1,000 c.c. (1 quart) per day.

VIII. The indigestible fiber content of the diet

Indigestible fiber is necessary if normal intestinal activity is to take place. There is general agreement that abundant fruits and vegetables should be included in the normal diet. The cellulose framework of these foods resists digestion in man and is eliminated from the body as roughage. Just how much roughage *should be supplied is a question. In certain types of constipation* roughage is undesirable. The use of the new "enriched," "restored" or "reinforced" milled flours and cereals assure products with a vitamin potency equal to the whole wheat flour but devoid of roughage. The quantity and quality of indigestible fiber to be included in the diet must be settled by individual experimentation.

IX. The acid base balance

Certain foods because of their mineral content leave an acid ash or produce an acid urine. Other foods leave an alkaline ash

as the end product of metabolic process The determining factor is the predominating mineral (see Minerals, Chapter 13)

Foods are classified as acid forming or base forming Meat *fish, eggs and cereals* are acid forming Milk, vegetables and fruits, with the exception of prunes, cranberries, and plums (see Minerals), are base forming Fats, sugars, and starches are neutral The normal diet should be neutral or slightly alkaline Original organic acidity, such as the tartness of oranges, due to their citric acid content, should not be confused with the acidity as an end result of metabolism

X Food idiosyncrasies

Unnatural food habits may be due to notions or to food allergies If they are due to the former, psychological adjustment should be undertaken If to the latter, the allergy should be strictly observed When, however, a food which is a dietary essential must be omitted from the diet, *it is imperative that it be replaced by some other satisfactory food or commercial product which will offset the elimination of the particular food* Allergy may seriously alter meal planning (see Chapter 41)

XI General

The attractiveness palatability, suitability, and cost of any diet are matters of importance In addition, general eating habits, *health habits, physical surroundings* and psychological response can, if they are adverse, offset many advantages of a proper diet

Gove Hambidge says in *Your Meals and Your Money** "After all the analysis and pulling apart has been done perhaps the larger significance of food study lies in three things It seems indicate very clearly That diet is a primary factor in enabling the individual to realize the highest physical well being of which he is capable within the limitations of his inheritance That whatever specific factors are responsible for specific results it is the whole picture that counts, the whole diet, the whole body, and the whole life That to attain the really profound effects of a superior diet takes a lifetime or even more than one generation All this opens up a new point, a sweeping panorama in

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deed and a new field of effort to the science of nutrition and by the same token as Sherman has pointed out it greatly increases the responsibility of the nutritionist in relation to human welfare Nobody has ever tried feeding a nation like a herd of thoroughbred animals just to see what would happen but I should like to see America start trying it "

CHAPTER 25

PLANNING THE FAMILY DIET

We know from scientific studies what is essential for normal, optimum nutrition, but how shall the meals be planned? This is not a complicated matter The daily or weekly inclusion of certain basic foods or food groups is assurance that fundamental requirements will be met After these foods have been included, *the remainder of the diet may be made up from foods of choice*

The first essential is **milk** If the daily diet contains 1 quart of milk, *there is at once protein of the highest quality*, fat, and carbohydrate (see Chapter 5) All the calcium needed, two thirds the requirement of phosphorus, one third the needed vitamin A one half the requirement of vitamin B_1, and over half of the vitamin B_2 will be present If only a pint of milk can be included each day, it will go a long way toward meeting requirements, but not in optimum amount

The milk may, of course, be drunk as such or made into cocoa cream soups, puddings, sauce for vegetables, or it may replace water in preparing cereals Cheese may be used to replace part of the milk intake The cheese equivalent of 1 quart of milk is *approximately one fourth pound, depending upon the texture* When cheese replaces milk, however, it must be remembered that *part of the minerals, the water soluble vitamins,* and the major part of the carbohydrate have been lost in the whey if the cheese is one made from curd alone If skim milk cheese is used, there is additional loss of cream or fat

Other equivalents for the quart of milk are the pint can of evaporated milk (16 ounces), 4½ ounces of dried whole milk, or 3½ ounces of dried skim milk plus 1½ ounces of butter

As a second essential, a **cereal** or cereal product should be eaten every day in addition to bread Breakfast foods today offer a wealth of choice We have wheat, oats, rice corn, barley, buckwheat and rye in their natural state, as well as the multiplicity of prepared cereals *Besides the breakfast foods* we have a great variety of pudding materials, tapioca, rice, sago, corn, and others, and in addition to bread we have muffins, rolls, biscuits

waffles, griddlecakes, and crackers. Choice should be a pleasant task. The preference should be for the whole grain or enriched cereals or cereal products. As has been stated before, the outside husk is removed in the finely milled cereals; consequently the minerals and vitamins are no longer present. Such cereal is of value only as a source of calories, small amounts of incomplete protein, and for its satiety value. With the possible exception of wheat and oats, the husk of most cereals is not too rough to prevent its inclusion in the normal diet. The bran layer of wheat and oats may be contraindicated for some individuals. To compensate for this, however, wheat germ may be used separately or enriched milled flour may be purchased. Wheat germ is rich in the vitamin B complex and in minerals, but has very little indigestible fiber.

The cereal group is, of course, of high caloric value, and because of its blandness may be included in good quantity. In addition, cereals furnish indigestible fiber to a varying extent (when not finely milled) and are excellent sources of phosphorus, sodium, magnesium, sulfur, and iron, and the vitamin B complex. Three to four servings during the day as a cereal or "bread" are desirable.

The third essential is **vegetables**, of which there is a variety. The leafy green salad vegetables are rich in minerals and vitamins (A, B complex, C, E, and K), but are low in protein, fat and carbohydrate. In fresh raw salads they retain their vitamins and minerals. If they are cooked, care must be exercised to prevent dissolving out the minerals and water-soluble vitamins. One green leafy vegetable should be included in the diet daily as a salad unless a raw fruit salad or raw fruit alone is served. A second vegetable should always be included in addition to potato—or a total of three, one of which should be raw if possible. In general the vitamin and mineral content of these last mentioned vegetables is low, but their caloric value is higher, and, unless a low caloric diet is desired, these vegetables add variety, color, and satiety.

Fruits are similar in composition to the vegetables, the difference being largely a matter of sweet carbohydrate (sugar) in place of starch. To insure adequate intake of vitamin C, it is wise to include routinely a citrus fruit in the daily diet if cost permits and if there is no sensitivity (allergy) to citrus fruits.

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The milk may, of course, be drunk as such or made into cocoa cream soups, puddings, sauce for vegetables, or it may replace water in preparing cereals Cheese may be used to replace part of the milk intake The cheese equivalent of 1 quart of milk is approximately one fourth pound, depending upon the texture When cheese replaces milk, however, it must be remembered that part of the minerals, the water soluble vitamins and the major part of the carbohydrate have been lost in the whey if the cheese is one made from curd alone If skim milk cheese is used, there is additional loss of cream or fat

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If the citrus fruit cannot be included, the need for salads and carefully cooked leafy vegetables and tomato (either raw or cooked) is increased One serving of citrus fruit, grapefruit or orange, nearly meets the day's requirement of vitamin C

Apricots, peaches, and, to a lesser extent, prunes have a place all their own among the fruits They are effective in hemoglobin regeneration, quite out of proportion to their mineral content For this reason, the inclusion of these fruits in the diet once a week or more is wise A second fruit daily is highly desirable Use fruits as dessert, at least part of the time

Meat It is possible to have the diet adequate in protein if ample milk, cheese, and eggs are included, but for satiety value nothing replaces the occasional use of meat To include meat daily greatly enhances the palatability and the food value of the diet Meat is an excellent source of protein, minerals and the B vitamins With the variety in cuts, combinations, and methods of cooking, no monotony need exist

Fish and meat are essentially interchangeable (see Proteins Chapter 5) The iodine content makes the use of salt water fish at least once weekly, desirable

Liver is considered separately from meat because it is meat de luxe from the standpoint of nutrition It has all the constituents present in other parts of the carcass, and, in addition, has a higher vitamin B potency, is a valuable source of vitamin A, and has no superior in any form as a blood regenerating food Liver revolutionized the treatment of anemia, and while it is rarely possible for a person to eat enough liver, as such, to control pernicious anemia, its concentrates are the most valuable form of medication in this disease, and certain amounts of liver in the diet are extremely important Liver should be served weekly in the normal diet The only difference in nutritive value among calf beef lamb, and pork liver is a variation in iron content and there is also a difference in the palatability and in the cost The milder the flavor (calf liver) the higher the cost It is essential that the liver juices be preserved in preparing liver for the table Soaking or parboiling to remove the strong taste also removes minerals and vitamins and this practice should be avoided

Eggs should be served daily if possible The yolk contributes vitamin A in good amount vitamin B_1 and is one of the few food sources of vitamin D The yolk also contains lecithin essential fatty acids and iron The white is pure albumin If eggs cannot be used daily, at least three a week should be consumed by the individual Boiled baked scrambled made into puddings cakes etc they play their part however they are used

Fats contribute calories to the diet, but in the basic diet they are important also for their vitamin cholesterol lecithin and essential fatty acid content Animal fats contribute vitamin A Butter cream and fish oils contribute vitamin D The seed oils such as cottonseed (Wesson) and corn oil (Mazola), furnish the unsaturated fatty acids vitamin B_6 (pyridoxine) and pantothenic acid Therefore a generous serving of both butter and salad oil daily is important

After the particular forms of food here mentioned have been included in the diet other foods according to fancy may be included to contribute the additional calories The foregoing basic diet will contribute about 1 000 calories These foods are found in the *Basic Seven Food Groups* (see Table 68) This **Yardstick of Good Nutrition** is a streamlined version of the recommendations of the Food and Nutrition Board (see Chapter 2) This suggests that certain items be chosen each day from specific food groups and that a variety of foods be chosen over the week Such choice assures adequacy of diet and conformation of the detailed standards (see Chapter 24) as can be seen readily from perusal of the groupings in Table 68 Such an instrument serves as a means of improving dietary habits without confusing the lay public with scientific details Details and reasons must be more slowly acquired

Fig 63 illustrates how each of these food groups may contribute part of the essential nutrients to the total day s diet These graphs represent the Basic Diet Plan of a 25 year old (see Table 74 Chapter 27) Some nutrients are above the Recommended Allowances in order to provide foods containing adequate amounts of other nutrients which are not as plentifully distributed

In planning the family diet many adjustments have to be made These may be such factors as various age levels within

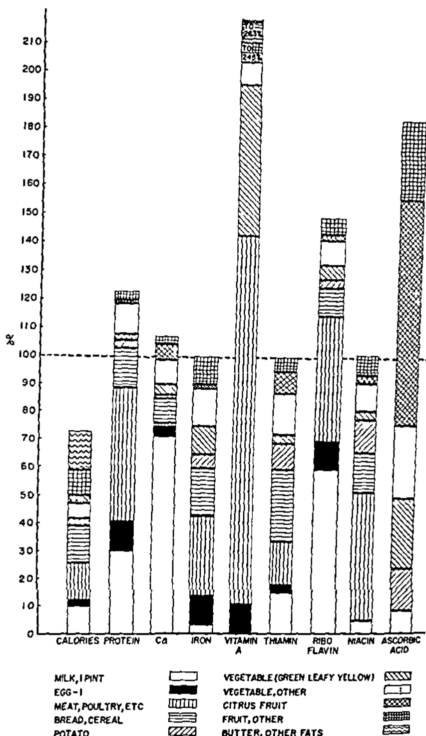


Fig 63.—How the food groups from Table 74 (Chapter 26) combine to meet the nutritive needs of a 25 year old woman Based on the percentage of each group of the daily recommended allowances The diet supplies adequate amounts of all nutrients except calories

Each family and each member of a family has certain foods which are favorites other foods which are not served very often Many food patterns are dictated by custom and cultural backgrounds (see Chapter 23) It is possible to include all of these variations in a weekly meal plan

The result of a recent Gallup poll of American eating habits indicates how few actually have a diet which is scientifically considered and conducive to optimum health The results of this poll showed—and we quote

Essential Foods	*How Americans Are Eating*
1 Green or yellow vegetables	23% had none
2 Citrus fruit, tomato or raw greens	46% had none
3 Other fruits or vegetables	9% had none
4 Milk or milk products	32% had none
5 Meat, fish or poultry	9% had none
6 Eggs	40% had none
7 Cereal or bread	4% had none
8 Butter or other fats	22% had none

The relation of this survey to another survey on illness may be significant This second survey showed that 16% of the total population or about 21 000 000 persons, in the United States were suffering from the common cold

Recent reports of the number of man hours lost a year to various illnesses are tremendously large, estimated at about 1 500 000

One of the most important influences in menu planning is the amount of money the family can budget for food The diet plan in Table 69 may be used for any economic level Some general principles can well be kept in mind to adjust it to different levels of income For instance, cereals in bulk, which are still available in some regions, are less expensive than the packaged varieties Cooking costs may be reduced by the use of a fireless cooker, by utilizing the top of a heating stove, or the ledge of the furnace Lower priced cuts of meat are as nutritious as the expensive cuts, except where bone content offsets the lower price paid In general cabbage, tomatoes, carrots, and potatoes are the cheapest vegetables, and there are none better Seasonal buying is a factor here also Fancy brands of canned goods offer no greater food value than cheaper brands A knowledge of can sizes and brands often effects a saving Canned or powdered milk may replace fluid milk, and skim milk may be substituted for whole milk (see Proteins, Chapter 5) As we have stated previously, legumes may replace in part milk egg meat protein Cot

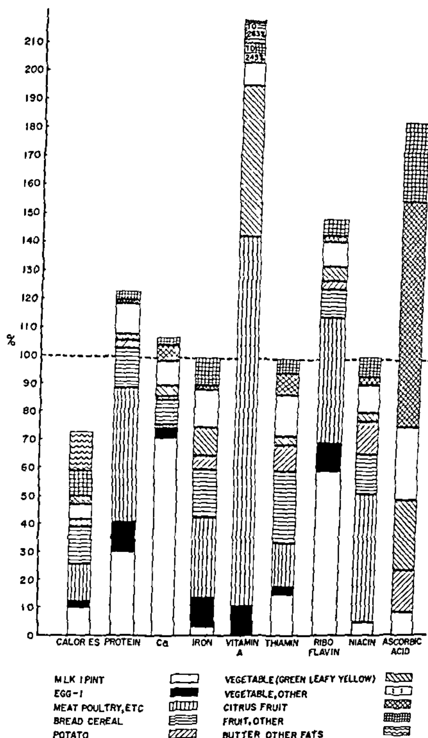


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TABLE 69

A FOOD PLAN FOR GOOD NUTRITION
(Quantities for one week)

KINDS OF FOOD	FOR CHILDREN 1 TO 6 YEARS	FOR CHILDREN 7 TO 12 YEARS	FOR GIRLS 13 TO 20 YEARS	FOR BOYS 13 TO 20 YEARS	FOR WOMEN: ALL ACTIVITIES	FOR WOMEN: PREGNANT AND NURSING	FOR MEN, ALL ACTIVITIES	TOTAL SUGGESTED FOR YOUR FAMILY
Leafy, green, and yellow vegetables	2-2½ lb	2½-3 lb	1½ lb	3½-4 lb	3½-4 lb	4 lb	3½-4 lb	
Citrus fruits, tomatoes	2-2½ lb	2½-3 lb	3 lb	3-3½ lb	2½-3 lb	3½-4½ lb	2½-3½ lb	
Potatoes, sweet potatoes	¾-1 lb	1½-2 lb	2½ lb	3½-4½ lb	2-3 lb	2-3 lb	3-5 lb	
Other vegetables and fruits	2 lb	2½- lb	3½ lb	3½ lb	3-4 lb	3-3½ lb	3-4 lb	
Milk, cheese, ice cream (milk equivalent)*	6 qt	7 qt	6-7 qt †	7 qt	5 qt	7½-10½ qt	5 qt	
Meat, poultry, fish‡	1-1¼ lb	2 lb	2½-3 lb	3 lb	2½-3 lb	3 lb	3-3½ lb	
Eggs	6-7 eggs	7 eggs	7 eggs	7 eggs	6-7 eggs	7 eggs	6-7 eggs	
Dry beans and peas, nuts	1 oz	2 oz	2 oz	4-6 oz	2-4 oz	2 oz	4 oz	
Baked goods, flour, cereals (flour equivalent)* Whole grain, enriched, or restored	1-1½ lb	2-3 lb	2½-3 lb †	4-5 lb	2-3 lb	2-2½ lb	3-7 lb	
Fats, oils	½ lb	½-1 lb	¾ lb	1-1½ lb	¾-1 lb	¾ lb	1-2 lb	
Sugar, syrups, preserves	¼-½ lb	¾ lb	1 lb	1-1¼ lb	¾-1 lb	¾ lb	1-1½ lb	

*For explanation of milk equivalent and flour equivalent foods see text.
†Larger quantities are for the younger girls.
‡To meet the iron allowance needed by children 1 to 6 years, girls 13 to 20, and pregnant and nursing women, include weekly 1 large or 2 small servings of liver or other organ meats.
From Nutrition Up to Date Up to You, U. S. Department of Agriculture, Bureau of Human Nutrition and Home Economics, February, 1950.

tage cheese is cheap and contributes valuable protein Oleo and nut margarines if reinforced with vitamin A may replace butter and are much less costly

Day old bread instead of freshly baked offers a saving The home baking of cakes and cookies and the preparation of puddings in the home rather than the use of packaged products is usually less costly Broken crackers broken rice, etc are cheaper than the whole products

However if the diet were forced to the monotonous level of whole grain cereals whole milk and raw cabbage it would be surprisingly adequate if taken in sufficient amounts as calculation of its content indicates Not desirable of course but possible

Radio programs newspapers and sometimes television programs provide information about the local prices so that the homemaker is aware of good buys and fluctuations in price An alert shopper manages the purchase of foods as carefully as a business is administered

Menus may be made more appealing by keeping in mind certain factors in the planning For example the colors of foods should harmonize A colorless meal can be colorless indeed as to taste just as a clash of colors may detract from palatability Cold foods should be served cold and hot foods hot and the temperature of the meal suited to the outside environment No meal should consist of all soft foods or all chewy foods A combination of crunchy and soft foods in the same meal makes the food more interesting Monotony of texture should be avoided as much as monotony of color

Foods bland in flavor are better if alternated with those having snap as to flavor Variety will lend appeal and no one food stuff should be predominant

We have endless flavorings spices and garnishes (parsley is not the only one) and meals become attractive looking from this standpoint with little effort

Concentrated foods are better coupled with bulky foods if total bulk and calorie balance are to be maintained

Do not serve the same food twice the same day Dress the leftovers up differently for another day

Except in extremely hot weather, it is well to plan a ho drink *or hot dish for every meal*, even hot biscuits or hot rolls for the sake of variety

Fresh vegetables, fruits, and fish served in season taste bette and give added zest to meals when their particular season ar rives

When the diet needs adjustment *other than to environment* let it be made carefully and with an understanding of the meta bolic *dysfunction, and with due consideration* of the patient as a person with rights and privileges Insofar as these are com *patible with his nutritional welfare they should receive* atten tion

In many diseases diet does not need adjustment (see specific discussions), but it must always be remembered that first and foremost *the individual has a body which must be maintained in as nearly perfect a state of nutrition as is possible, and second, that due to some abnormality, certain foods may not be used in normal fashion Only such foods as require alteration in kind or amount* should be changed and after such a change is made, there should *be assurance that a dietary deficiency will not result which may* be as serious as the disease the diet is designed to alleviate

Dr Alvarez aptly expressed the need for sound dietetic in formation when he said that the pressure of opinion produced by the campaign for vitamins, roughage, green and raw foods was so great that it could be withstood only by a determined and thoughtful person who was well supplied with facts

All *peoples* regardless of cultural background economic or social status or personal characteristics require the same kind of *food, for body needs do not change* But all these varying cir cumstances must be taken into consideration at times in plan *ning the diet Environment and state of health also* exert modi fying effects With thought it is usually possible to secure ade quate *food intake in any of these circumstances,* but too fre quently diets needlessly fail of their purpose No diet will be *long tolerated which departs radically from habits of years'* standing, is difficult to obtain under existing living conditions or under the economic *limitations of the individual, or* which may make him conspicuous Any diet planned for the normal

the chronically ill, or the acutely ill person must be flexible enough to permit adjustment within the major food groups so that food familiar and appetizing to the individual may be utilized

In Part V are listed several excellent publications invaluable to the food planner when she is faced with the many factors which arise to make necessary adjustments in the diet

PART III

MODIFICATIONS OF THE NORMAL DIET

CHAPTER 26

THE PATIENT

The current trend in therapy is to consider the patient as a whole person in dynamic interaction with the forces that comprise his social setting. Thus, those who are concerned with helping the patient must interest themselves with the details of his environment as well as the symptoms of his physical ailment. For example, a patient whose cooking facilities were limited to a one burner hot plate might be blithely told to "only broil or roast meats," if this information were not obtained.

From this modern approach to patient therapy has evolved the concept of the "therapeutic team." Each member of the team, the physician, the medical social worker, the nurse, the nutritionist, the laboratory technician, pools his specialized knowledge of the patient, and from this aggregate information the total treatment of the patient is prescribed by the physician. It is not possible to always have all of these specialists in each situation. Often, the nutritionist, the medical case worker, the nurse and the laboratory technician are available to the physician only on a consultation basis. However, in so far as possible, the approach to the therapy of the patient usually follows the several pathways represented by each of these specialties instead of isolating his medical condition from his social setting which was often the practice in the past. This may be true if the therapeutic team is a "one man team" (the physician) or a team composed of many specialists.

Before any specific diet therapy is prescribed for the patient it is believed necessary to evaluate his present nutritional status. This evaluation may be obtained through four separate areas of investigations: the nutrition history, the clinical examination, the medical examination and the laboratory examination. Whenever possible all are performed and, when the information from

each are "pooled" a fairly comprehensive indication of the patient's nutritional status is secured The medical and the laboratory examinations are beyond the scope of the present book and so they will only be mentioned briefly The clinical examination is of related interest and consequently will be discussed The nutrition history is of primary importance and will be presented in detail

The purpose of the **nutrition history** is to discover the usual food pattern over a relatively long period of time This may be contrasted with the diet record and the recall method which aims to obtain information about the amounts of foods eaten within a specified time Since the amounts of food recorded are only estimates it has been found that the patient in his notations usually underestimates the food consumed The time period is also one of the areas of greatest error in the diet record and recall method Records of several days or recalls for 24 hours do not provide a basis for generalizations about the patient's regular diet However these methods can be used most advantageously as a foundation for nutrition education

A third type of evaluation of nutrition intake is that used primarily for research This constitutes accurate weighing of the food eaten by the patient either by the patient himself or the investigating personnel

A fourth and still more refined method of ascertaining nutrient intake is by chemical analysis Food which is duplicated in every respect (including weight) is determined by analysis for nutrient content

For the most part the nutrition history with perhaps a 24 hour recall as a cross check or contrast is the most acceptable means of obtaining the usual food intake of a patient Not only does it reveal major deviations from the universally held concept of good food habits but it can also provide a basis for nutrition education When other examinations the medical clinical or the laboratory have indicated that a nutritional deficiency might exist an examination of the dietary intake of the patient may indicate whether or not the condition were related to the ingestion of nutrients Jolliffe has indicated that a rapid evaluation of the dietary pattern in qualitative terms (the nutrition history) would be all that is really necessary in the office hospital, or

clinic. The basic seven is often used as a standard with which to evaluate the nutrition history of the patient.

There are many nutrition history forms which are used by clinics or hospitals. Each one has been compiled with the needs of the specific institution in mind. However, as indicated previously, it is necessary to obtain information about the environment, such as the home, working conditions, economic status and background of the patient, as well as specific information about his food habits. Table 70 represents a possible nutrition history form. The interviewer asks the questions and notes the answers in the proper place; the patient does not "fill out" the form. Thus, not only is it important to learn what the patient is in the habit of eating, but it is equally necessary to know how he eats, where he eats, when he eats, and the possible range of his eating pattern.

An effective nutrition interview is quite difficult. It takes considerable practice and skill to conduct an interview so as not to suggest a desired answer and to obtain accurate information. As Babcock pointed out, the interviewer must be flexible and must have a warm and unjudging attitude. The nutritionist (or anyone else conducting the interview) will be able to secure important information if she is aware of the differences in dietary practices that might exist from one ethnic group to another, and from one social situation to another. (See Chapters 1 and 23.) The nutritionist should realize that the patient may be anxious, tense, and apprehensive about his physical ailment. Throughout his nutrition interview, the patient may express this anxiety in many ways. He may seem physically uneasy and restless. He may break forth in self-conscious laughter or, conversely, he may maintain an uncompromising silence. If the nutritionist realizes that these manifestations are not an expression of personal animosity, his anxiety can perhaps be redirected toward an active participation in his own interest. Thus, by conveying to the patient sincere sympathetic understanding the nutritionist can put the patient so at ease that she can obtain useful information and encourage the patient to be receptive to any necessary dietary adjustment.

The nutrition interview contains such valuable information that it should become part of the patient's medical record. This is done in many hospitals and clinics. Likewise, the physician's

TABLE 10

NUTRITION HISTORY AND RECORD

Name　　History No　　Date
Address　　Age　Sex　M S W D Sep
Telephone (home)　　(business)
Occupation　　Hr/wk　　Travel hr/wk
Height　　Actual weight　　Ideal weight

Medical Information

Sleep av hr/nt　　Medication yes　　Smoke? yes
during day　　no　　no
　　Type　　pk/da
Gastrointestinal　　Vitamin preparation　　Recreational activity
constipation　　yes　　hr/da
elimination　　no　　hr/wk
gas　　Type　　Type
diarrhea
Have you ever had any illness other than childhood communicable diseases?
Yes　No　Which ones?　　When?
Did you ever have an operation?
Yes　No　Designate
Are your teeth in good condition? Yes　No　Dentures

Family Information

Number in family　Adults　　Children
Type of dwelling　Apt　House　Room　Dormitory
Family eats together　Breakfast　Lunch　Dinner　Evening
Does family have large get togethers ?　Weekly　Monthly
If you have guests in the evening do you serve cake or dessert
fruits　sandwiches or delicatessen　candy　?
Who prepares meals　Mother　Grandmother　Self　Other
Who shops for foods?　Mother　Father　Grandmother
Self　Other
Are other members of your family of normal weight according to height weight tables?　Yes　No　Who?

Food Habits

Where do you eat　Breakfast (B)　Lunch (L)　Dinner (D)
Midmorning　Midafternoon　Midevening
How much time do you allow for　B　L　D
Do you eat each meal at the same time each day?　B　L　D
Even
Do you have a good appetite? Yes　No
Do you eat meals alone? B　L　D　Evening
How many times a week do you omit B　L　D　?
Do you budget money for your food? Yes　No　Be careful
Do you have an all gone feeling between meals? Yes　No
Do you take extremely hot foods? Yes　No　Sometimes
cold foods? Yes　No　Sometimes
highly spiced foods? Yes　No　Sometimes
Are you a candy eater? Yes　No　Amt/da
Are you fond of rich foods such as pie or rich cake pastries etc ?
Yes　No　Amt/da　Amt/wk
Do you smoke immediately before eating? Yes　No
Do you smoke during meals? Yes　No
Do you chew tobacco? Yes　No　Amt/da
Do you drink coffee during the day? Yes　No　Amt/da

TABLE 70—CONT'D

Food Intake

Morning	
Fruit	
Cereal	
Eggs	
Meat	
Bread	
Butter	
Beverage	
Sugar	
Cream	or Milk
Additional	
Noontime	
Soup	
Meat or meat substitute	
Potato	
Vegetable—Raw	
Cooked	
Bread	
Sandwich	
Butter	
Dessert	
Beverage	
Sugar	
Cream	or Milk
Additional	
Night time	
Soup	
Meat or Fish	
Potato	
Vegetable—Raw	
Cooked	
Bread	
Butter	
Dessert	
Beverage	
Sugar	
Cream	or Milk
Additional	

Summary of Intake

Food	*Total*
Milk—fresh	
canned	
dried	
Cheese	
Eggs	
Meat	
Fish	
Legumes	
Bacon	
Cream	
Butter	
Oil—other fat	
Fruit—raw	
cooked	
Veg.—raw	
cooked	
Potatoes	
Potato substitute	
Cereal—refined	
whole grain	
Bread—refined	
whole grain	
Crackers	
Sugar	
Desserts	
Miscellaneous	
Tea	
Coffee	
Alcoholic beverages	
Water	
Vitamin medication	
Foods omitted and why	

diet prescription and the diet which the nutritionist and the patient worked out should also be included. The subsequent nutrition interviews which indicate the patient's progress are usually noted on the medical record.

Because the teacher, the school nurse, and the mother are in daily contact with children in school (or the public health nurse with the patient), symptoms of early deficiency diseases may be detected by others than the physician. In 1942 an excellent summary of clinical criteria of early deficiency disease symptoms in human beings appeared in the February and March issues of the *Journal of the American Medical Association*. The data were

adapted for the Edition of Nutritional Charts compiled by the H J Heinz Company These outlines reproduced by permission appear in Table 71

In discussing the detection of nutritional deficiencies by clinical examination Jolliffe in *Clinical Nutrition*) suggested the evidence be treated cautiously for the following four reasons (1) for the most part the deficiency signs are nonspecific and they can be provoked by factors other than malnutrition (2) malnutrition may occur in persons who have eaten diets which may be considered adequate these symptoms may be brought about by such things as interference with digestion absorption or utilization or increased nutrient needs and so on (3) there is a difference between acute and chronic lesions and (4) deficiency diseases are frequently multiple and therefore the condition is a complex picture

Thus the nurse or the teacher using the information set forth in Table 71 as a guide may detect an indication of a condition out of the ordinary and thereby quickly refer the individual to the physician for early treatment

TABLE 71

CLINICAL CRITERIA OF EARLY DEFICIENCY DISEASE SYMPTOMS IN HUMAN BEINGS

SYMPTOMS	PHYSICAL SIGNS
Infants and Children	
1 Lack of appetite (L)	1 Lack of subcutaneous fat (N)
2 Failure to eat adequate breakfast (L)	2 Wrinkling of skin on light stroking (N)
3 Failure to gain steadily in weight (L)	3 Poor muscle tone (D)
4 Late period of sitting standing and walking (N)	4 Pallor (N)
5 Aversion to normal play (L)	5 Rough skin (toad skin) (N)
6 Chronic diarrhea (L)	6 Hemorrhage of newborn (K) (D)
7 Inability to sit (L)	7 Bad posture (I)
8 Pain on sitting and standing (L)	8 Nasal blackheads and whiteheads (N)
9 Poor sleeping habits (L)	9 Sores at angles of mouth cheilosis (L)
10 Backwardness in school (L)	10 Rapid heart (N)
11 Repeated respiratory infections (L)	11 Red tongue (D)
12 Abnormal intolerance of light photophobia (L)	12 Square head wrists enlarged rib beading (N)
13 Abnormal discharge of tears (I)	13 Vincent's angina thrush (D)
	14 Serious dental abnormalities (N)
	15 Corneal and conjunctival changes—slit lamp (D)

TABLE 71—CONT'D

SYMPTOMS	PHYSICAL SIGNS
Adolescents and Adults	
1 Lack of appetite (L)	1 Nasolabial sebaceous plugs (N)
2 Lassitude and chronic fatigue (L)	2 Sores at corners of mouth, cheilosis (L)
3 Loss of weight (L)	3 Vincent's angina (D)
4 Lack of mental application (L)	4 Minimal changes in tongue color or texture (D)
5 Loss of strength (L)	5 Red, swollen lingual papillae (D)
6 History of sore mouth or tongue (L)	6 Glossitis (D)
7 Chronic diarrhea (L)	7 Papillary atrophy of tongue (D)
8 Nervousness and irritability (L)	8 Stomatitis (D)
9 Burning, pricking of skin, paresthesias (L)	9 Spongy, bleeding gums (L)
10 Night blindness (N)	10 Muscle tenderness, extremities (D)
11 Abnormal intolerance of light, photophobia (L)	11 *Poor muscle tone* (D)
12 Burning or itching of eyes (L)	12 Loss of vibratory sensation (D)
13 Abnormal discharge of tears, lacrimation (L)	13 Increase or decrease of tendon reflexes (D)
14 Muscle and joint pains, muscle cramps (L)	14 Hyperesthesia of skin (D)
15 Sore, bleeding gums (L)	15 Bilateral symmetrical dermatitis (D)
16 Tendency to bleed (N)	16 Purpura (D)
	17 Dermatitis, facial butterfly Casál necklace, perineal, scrotal, vulval (D)
	18 *Thickening and pigmentation* of skin over bony prominences (D)
	19 Nonspecific vaginitis (D)
	20 Follicular hyperkeratosis of extensor surfaces of *extremities* (D)
	21 Rachitic chest deformity (D)
	22 Anemia not responding to iron (D)
	23 Fatigue of accommodation (D)
	24 Vascularization of cornea (D)
	25 Conjuctival changes (D)

Ma ... ntry than most
people ... re as most
bad d ... symptoms
obser ... defic ency
of sev ... toms listed
in the ... y all single
nutrit ... the symp
toms ... conditions
than

The detection of an early stage of dietary deficiency is important Some signs are such as might be noticed by observant laymen such as parents or teachers for example others obviously require for their detection the more detailed knowledge and experience of a nurse still others will be seen and properly interpreted only by the *skilled physician* The classification of symptoms and signs was prepared by the Subcommittee on Medical Nutrition Division of Medical Sciences National Research Council The letters L N and D in parentheses refer to layman nurse and doctor respectively as the persons who might be expected to make the observation in question

The medical or physical examination of the patient is conducted by the physician While examining the patient the physician often finds evidence of malnutrition along with manifestations of other illness Recently, Jolliffe (in *Clinical Nutrition*) clearly and concisely discussed the pathogenesis of malnutrition He defined a nutritional deficiency disease as one which was caused by a nutritional inadequacy Nutritional inadequacy results whenever adequate amounts of essential nutrients are not provided to tissues which require them for normal functioning ' He pointed out that there may be a primary nutritional inadequacy or a secondary or conditioned nutritional inadequacy The former can be caused by a dietary inadequacy whereas the second may result from various factors which interfere with ingestion digestion absorption or utilization of essential nutrients In addition increased requirements of nutrients or a destruction of nutrients may contribute to a conditioned malnutrition

Tables 72 and 73 summarize the gross evidence of malnutrition possible special examinations to aid in the detection of malnutrition and a listing of such factors which might bring about a conditioned malnutrition

Disease is a chemical problem in which all possible influencing factors in its development must be considered Whenever a deficiency is suspected of being a possible factor in the patient s symptoms the absorption and use of the nutritional elements and their quantitative intake should be evaluated It is especially necessary to recognize the importance of the summation of several conditioning factors Adequate dietary intake or adjustment to meet specific needs is probably of wider importance than is at present recognized

The true deficiency diseases have been discussed in Chapters 11 and 12 These conditions as described and illustrated may not be frequently seen at such an advanced stage but subclinical symptoms or conditions which can readily be visualized as forerunners of these more advanced clinical pictures are not uncommon Many vague symptoms characterized by indigestion joint pains fatigue mild skin disorders sore mouth etc can many times be shown to be subclinical deficiencies of vitamins or some other food constituent

TABLE 72

Gross Evidences of Malnutrition

SYSTEM	FINDING	SUGGESTED DEFICIENCY OR SYNDROME
Eyes	Xerosis conjunctivae and corneae	Vitamin A
	Central ophthalmoplegia	Thiamine
Mucous membranes	Scarlet red stomatitis and glossitis with or without secondary Vincent's infection	Nicotinic acid
	Magenta glossitis	Riboflavin
	Atrophic glossitis	Nicotinic acid, B complex, *Addisonian anemia*, Plummer Vincent syndrome
	Scorbutic gums	*Ascorbic acid*
	Cheilosis	Riboflavin
	Nonspecific urethritis, balanitis, vaginitis	Nicotinic acid
Skin	Pellagrous dermatitis	Nicotinic acid
	[illegible]	Riboflavin
	[illegible]	Vitamin A
	[illegible]	*Vitamin K, ascorbic acid*
	[illegible]	Riboflavin
Neurological	*Characteristic bilateral symmetrical polyneuropathy*	*Thiamine*
	Combined system syndromes	Thiamine, B complex, *Addisonian anemia*
	Wernicke's syndrome	Thiamine, B complex
	Nicotinic acid deficiency encephalopathy	Nicotinic acid
	Progressive stupor and hebetude	*Nicotinic acid*
	Certain organic reaction psychoses	Nicotinic acid thiamine, and B complex
Skeletal	Rachitic deformities and osteomalacia	Vitamin D, calcium phosphorus
General	Underweight, underheight, edema, pallor	Calories, proteins, iron, B complex

Roentgenogram of hand and wrist, elbow and hip	Rickets and scurvy in children, *osteomalacia* and scurvy in adults
Roentgenogram of heart	Advanced beriberi
Electrocardiogram	Changes suggestive of thiamine deficiency
Biomacroscopic eye examination with slit lamp	Capillary invasion of cornea (riboflavin deficiency), changes in conjunctivas (vitamin A deficiency)

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TABLE 72—CONT'D

Special Examinations for Detection of Malnutrition

EXAMINATION	CONDITION IT MAY DETECT
Red blood cell count Hemoglobin Stained blood smear Red blood cell volume	Iron deficiency anemia, Addisonian anemia, macrocytic anemia
Plasma ascorbic acid	Vitamin C undersaturation
Serum calcium Serum phosphatase Serum phosphorus	Vitamin D deficiency
Blood pyruvic acid	Vitamin B_1 deficiency
Serum protein or albumin	Protein deficiency
Blood prothrombin	Vitamin K deficiency

The term subclinical is used to indicate that the complete picture of the deficiency is not present at the moment, but is potentially so, and it may be precipitated suddenly by some stress or strain (overfatigue, infection, pregnancy, etc) or by a longer time interval itself These symptoms frequently confuse the clinical picture and are added reasons for obtaining a complete dietary history

After the detection of a possible nutritional deficiency, the diagnosis may be confirmed by either what is known as a therapeutic trial or laboratory examination Therapeutic trial consists of supplying the suspected missing nutrient A considerable amount of time may elapse before an improvement is noted A laboratory examination may include tests upon the tissues, blood urine or feces As mentioned previously it is beyond the scope of this book to consider the number, the methods and the validity of such tests It is sufficient to be aware of their contribution to the diagnosis of the nutritional status of the patient

Thus, in order to consider the patient as a "whole" person, not his medical condition alone information must be obtained about the factors that influence his environment This can be acquired through the combined information gathered by the "therapeutic team" The influences which are related to the nutritional status of the patient may best be obtained from a nutrition history from a medical, clinical, and laboratory examination Once the nutritional status of the patient has been de

TABLE 73

Factors Interfering With Ingestion

1 Gastrointestinal disorders
   Acute gastroenteritis, gall bladder disease, peptic ulcers, diarrheal dis eases and obstructive lesions of gastrointestinal tract
2 Neuropsychiatrical disorders
   Neurasthenia, neurosis, psychoneurosis, psychoses, migraine, and neu rological disorders interfering with self feeding
3 Anorexia
   Alcohol, operations, anesthesia, infectious diseases, congestive hear failure, thiamine deficiency, visceral pain
4 Food allergy
5 Loss of teeth
6 Pregnancy
7 Therapy
   Diets restricting ingestion of essential foods

Factors Increasing Nutritive Requirement

1 Abnormal activity, associated with prolonged strenuous physical exertion delirium, and certain psychoses
2 Abnormal environmental factors
   Excessively high temperatures, as in the tropics, in deserts, and in certain industries
   Excessive light glare as from snow or kleig lights
3 Fever
4
5
6 , parenteral dextrose solu

Factors Interfering With Absorption

1 Gastrointestinal diseases associated with hypermotility or reduction o absorbing surfaces
2 Achlorhydria
3 Biliary disease, especially obstructive jaundice
4 Vitamin deficiency
5 Therapy
   Liquid petrolatum, colloidal adsorbents, severe catharsis, gastric o intestinal resections, and short circuiting operations

Factors Interfering With Utilization

1 Hepatic dysfunction, as in liver disease, diabetes mellitus, alcoholism
2 Hypothyroidism
3 Malignancy
4 Therapy
   Sulfonamide drugs, radiation therapy, phenytoin

Factors Increasing Excretion

1 Polyuria, as in diabetes mellitus, diabetes insipidus
2 Lactation
3 Excessive perspiration
4 Therapy
   Long continued excessive fluid intake, as in urinary tract infections

Factors Increasing Destruction

1 Achlorhydria
2 Lead poisoning? trinitrotoluene poisoning?
3 Therapy
   Alkalis, sulfonamides, arsenicals

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termined, then the specific diet prescription may be based on the evidence gathered by these methods in order to correct past deficiencies and to prevent future ones

Review Questions

1. What is meant by the concept of the "therapeutic team"?
2. Who might be the members of such a team?
3. How may the nutritional status of the patient be evaluated?
4. What is the purpose of the nutrition history?
5. What is the difference between the nutrition history, the diet record, and the recall method?
6. What are some of the limitations of each method of evaluating the patient's food intake?
7. What are five important points to keep in mind when conducting a nutrition interview?
8. What is the difference between a primary and a secondary nutrition deficiency and what might contribute to each one?
9. What is meant by the term "subclinical deficiency"?

Suggested Project

1. Using the Nutrition History and Record Form in Table 70 conduct a nutrition interview with one of your colleagues Carefully evaluate the experience in terms of such factors as how did the "patient" feel about the interview, how secure was the interviewer in the technique, how well do you think you know the patient on the basis of this interview, will you be able to adjust a diet, such as weight loss, to his diet pattern, and, if you were to do a second interview, how would it differ from the first?

CHAPTER 27

GENERAL SUGGESTIONS FOR DIET THERAPY

> The present day concept of diet therapy is the modification of the normal diet. Unless the previous nutritional status and the kind, severity, and duration of the illness indicate otherwise, this is probably adequate for most patients. The normal diet may be modified in several ways. The general or "house" diets are usually modified in terms of physical consistency, i.e., light, soft, and liquid. In all diet therapy the patient is of primary importance so an individualized approach will insure food acceptance.

The primary objective of any dietary regimen is to either maintain or to bring about good nutritional status in the individual. The term diet therapy implies treatment by diet which will improve the clinical condition of the patient and still keep within the framework of this fundamental objective. Thus, treatment of any clinical condition must take cognizance of the fact that the patient's specific ailment is of no greater importance than the patient himself as an entity. All too often in the zeal to relieve a specific dysfunction, dietary restriction is such that deficiencies occur.

The changing concept in the philosophy of diet therapy reflects a concern for this often misguided enthusiastic but extreme restriction. Diet therapy originally was spoken of in terms of the "special diet" which usually suggested a "take away" situation. Today, the concept is based on a modification of the normal diet. Using a normal diet as a basis, diet therapy may modify the diet in physical consistency, in quantity of specific nutrients, in methods of service, in methods of preparation, in flavor, and, last, the modification may be a combination of any or all of these variations. For example, a diet may be liquid, higher than normal in calories, fed through a tube, prepared in a blender, and with no added condiments. Whenever the modified diet is discussed in relation to a specific clinical condition, each one of these possible modifications will be considered.

Along with the changing concept in the approach to diet therapy an effort has been made to improve the nomenclature of the diets Corinne H Robinson as Chairman of the Diet Therapy Section of the American Dietetic Association reported at the annual meeting in 1951 the characteristics of good dietary nomenclature Four desirable points in naming the diets were suggested

1 Terminology should be related to the modifications of the normal diet i e it should be stated as an increase in one or more nutrients a change in consistency flavor etc
2 It should specify nutrient levels whenever quantitation is essential to the success of the diet
3 Reference to diseases or symptoms should be avoided in describing a diet
4 Names of persons should not be used to designate a diet since the underlying principles are usually not clear

It is true that many diet manuals have adopted these desirable characteristics However the goal of diet therapy is to have as much as possible a universal understanding so that a Bland 500 mg Sodium Diet will have the same connotation in Los Angeles that it has in New York

As indicated in Chapter 26 the nutritional status of the patient should be ascertained before a dietary prescription is suggested Various methods of determining this and several factors influencing nutritional status were suggested In addition Pollack and Halpern in *Therapeutic Nutrition* (Bulletin No 234 National Research Council) set forth the factors that determine the nutritional requirements of the hospital patient These are

1 The previous nutritional state of the individual
2 The nature and severity of the pathological abnormality present
3 The amount and character of the nutrient which is being lost from the body
4 The anticipated duration of the injury and disease

It should be kept in mind that the nutritional requirements will probably vary with each patient and the diet prescription should

PATTERN FOR 25 YEAR OLD "REFERENCE" WOMAN

(Nutritive Needs Other Than Calories)

FOODS	AMOUNT	CALORIES	FOODSTUFFS: PROTEIN GM	FAT GM	CARBOHYDRATE GM	MINERALS: CALCIUM GM	IRON MG	VITAMINS: VITAMIN A I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG	VITAMIN D I U
Milk, whole	1 pint	232	17	19	24	0 576	0 4	(3,100)	0 180	0 840	0 6	6	40
Egg	1	77	6 1	5 5	0 3	0 026	1 3	550	0 040	0 130	Trace	--	27
Meat, fish, poultry*	4 oz E P	320	25 6	18 1	1 7	0 014	3 5	7,106	0 193	0 649	5 7	--	6
Bread—cereal whole grain or enriched**	4 slices	263	8 7	3 5	48 7	0 064	2 0	----	0 290	0 145	1 7	--	--
Potato—cooked	1 small (100 gm)	98	2 4	0 1	22 5	0 013	0 8	20	0 110	0 050	1 4	12	--
Vegetable, green or yellow†	1 average portion	22	1 5	0 2	5 0	0 043	0 9	2,888	0 046	0 080	0 5	20	--
Vegetable—other‡	2 average portions	118	5 6	1 2	23 2	0 056	1 8	296	0 188	0 122	1 2	20	--
Fruit—citrus	4 fl oz	54	1 0	0 2	13 0	0 047	0 2	(230)	0 095	0 030	0 3	61	--
Fruit—other§	2 average portions	190	1 4	0 3	26 0	0 024	1 2	2,136	0 088	0 096	1 0	20	--
Butter, fortified margarine—oils¶	3 Tbsp	325	0 2	36 6	---	0 006	---	920	----	----	---	--	--
Total		1,699	69 5	84 7	164 4	0 869	12 1	13 916	1 23	2 142	12 4	139	73
N R C Recommendations 25 yr ref woman		2,300	55		---	0 8	12	5,000	1 2	1 4	12	75	--

The nutritive value of the following foods was calculated and then averaged for representative portions for each category

*82 gm hamburger cooked 95 gm baked codfish steak 95 gm lamb breast stewed 80 gm shoulder pork chop fried 100 gm stewed chicken breast 74 gm beef liver fried 80 gm chuck pot roast

** 3 slices white enriched bread ½ cup cooked oatmeal

†100 gm canned green asparagus ⅓ cup cooked green snap beans 100 gm (1 large stalk) broccoli 50 gm (½ cup shredded) raw cabbage 75 gm (½ cup) cooked carrots 50 gm (2 large leaves) escarole 100 gm (¼ cup) baked winter squash

‡130 gm (½ cup) canned baked beans 83 gm (½ cup) cooked red beets 60 gm (½ cup) cooked cauliflower 83 gm (½ cup) canned corn (drained solids) 100 gm (½ cup) cooked frozen green peas 100 gm (⅔ cup) cooked white turnips 78 gm (½ cup) cooked turnips

§115 gm (1 medium) baked apple with 2 Tbsp sugar 150 (1 med) raw apple 150 gm (1 med) raw banana 150 gm (¼ 4½ in) cantaloupe 100 gm (2 halves) canned peaches syrup pack 1 Tbsp juice 85 gm (4 5 medium) prunes cooked with sugar 1 1½ Tbsp. juice 100 gm (½ cup cubes balls) watermelon

¶14 gm (1 Tbsp) butter 14 gm (1 Tbsp) margarine 14 gm (1 Tbsp) oil (peanut corn olive)

be planned for each individual. However, after recognizing this point there are certain clinical conditions which alter the basic nutritive needs. These will be discussed for general application.

Many dietary regimens use the recommended dietary allowances of the National Research Council as the nutrients required for therapeutic diets. These allowances (Chapter 2) were meant to meet the needs of the *normal* individual. Therefore, the use of these allowances should be restricted to a foundation upon which to build the various needs in diet therapy. Thus a basic diet should be set forth and then modifications made according to the four factors suggested by Pollack and Halpern which were cited above. Such a basic or normal diet has been calculated and will be used as a basis for modification throughout the Diet Therapy section. Table 74 represents the Basic Diet planned from the food groups discussed in Chapter 2 for the "reference woman" of 25 years. The diet plan meets the recommendation in all nutrients except calories. These could easily be added by the use of pastries, sugars, fats, starches, and larger portions of the calculated food. These are usually included in the normal diet. It is of interest that it was necessary to increase the protein intake above the recommended amount in order to arrive at the needed iron allowance.

As was indicated, it has been suggested that the hospitalized patient probably has an increased need for many nutrients above that of the normal person. Little is known about the specific amount of each nutrient. However, from the information available some recommendations can be made for modification.

It is important to see that patients do not remain in negative energy balance longer than necessary. Pollack and Halpern state that "weight loss is *not* an inevitable result of disease or injury and can usually be minimized by sufficient attention to nutrition." A review of Chapter 7 will point out that if sufficient calories are not supplied by fats and carbohydrates, then protein needed elsewhere will have to provide the needed calories either from the diet or from tissue protein. This in turn can use serious side effects. The caloric requirement increases with increase in the individual's activity. This is also true of the hospital patient. It has been shown that restlessness in bed may increase caloric expenditure by 10 to 20%. Specific conditions such as fever (see Chapter 29) increase the require

ment even more However, the average adult afebrile patient with only a minor illness or injury at bed rest needs about 2 000 calories per day

Although it is recognized that the **protein** needs of the patient are increased markedly in many clinical conditions, it has been suggested that the National Research Council recommended allowances could usually be considered adequate for those patients who are ambulatory or who are hospitalized for a short time It is assumed that the protein be of high biological value and that it be consumed by the patient

Because of the lack of research related to changes from normal requirements for **vitamins** in disease and injury, it has become an accepted procedure to supplement the diet up to as much as ten times the normal daily recommended allowances From the limited evidence available, these quantities seem to be adequate for minor illnesses of approximately 10 days' duration However, if the illness is severe, or such that the interrelationships among the nutrients are impaired, then an additional allowance may be needed These are usually given in the form of supplements, as the amount of food which would supply this quantity of the vitamins perhaps would be beyond the ability of the patient to consume

The **electrolyte content** of the body is one of the primary regulators of many processes In many clinical conditions the normal functioning of one or more mineral elements are disturbed and, consequently, the present treatment often indicates a modification of the intake of that specific element in food During periods of stress, abnormal demands are placed on the electrolytes within the body These are special situations and will be treated in specific chapters However, since most of the elements are so well distributed in foods it is doubtful if the ambulatory patient will suffer from a mineral deficiency, that is, provided he eats a full tray "

Thus it can be concluded that for the present at least, if the patient has no fever, is suffering from a minor illness, is hospitalized 10 days or less, and ingests all his food he may be maintained in good nutritional status on a diet that includes the recommended daily allowances of a normal individual in his classification It is assumed that he has sustained no nutritional deficiencies prior to the present illness However, apart from

these severe limitations the majority of the patients have nutrient needs far beyond those of the normal individual These will be discussed in each related chapter

The Standard Hospital Diets

Most hospitals plan menus for what is known as the "standard" or "house" diets These represent the normal diet and modifications in physical consistency which might be used for many of the patients These menus may also be modified in terms of preparation The house diets provide a basis from which any additional modification such as in flavor in specific nutrients and in types of service may be made The house diets include the following which are a progressive change in physical consistency the regular or house diet (as it is sometimes called) the light diet the soft diet and low fiber diet and the full liquid diet Some hospitals are routinely adding a 125 gm protein diet to their standard diets

The **regular or house** diet is the normal diet which was discussed previously Recognizing the need for personalizing the diet so that the patient will ingest the tray that is sent to him adaptation of the normal diet is made for each patient in so far as possible Many minor adjustments which take cognizance of his likes and dislikes such as milk for breakfast or an extra pat of butter with dinner will assure a receptive attitude toward any dietary regimen The standard house diet can also be easily changed to meet individual calorie needs

In some institutions specific meats and some vegetables are excluded from all hospital trays Others have adopted a more progressive policy and include all foods on their standard menu There seems to be a wide variety of opinion however the trend seems to indicate the acceptance of foods formerly prohibited Clear cut experimental evidence that differences in variety exist is lacking It is rather the method of preparation which seems to make a difference Logically unless the patient is suffering from a condition which prevents the proper digestion and absorption of foods there seems to be no justification in depriving him of tasty, well prepared variety in trays

The **light diet** is a slight modification of the normal diet In many hospitals this classification does not appear in diet therapy The degree of its modifications seem to vary from hospital to

hospital In general, it consists of what might be called the "simple" foods In terms of physical consistency, raw fruits and vegetables are prohibited, lettuce and tomato frequently being the only exceptions Cooked whole vegetables and fruits are allowed, as well as whole meats Doughnuts, pastries, fried meats and other fried foods, and highly spiced foods are withheld The light diet is the steppingstone between the soft low fiber diet and the regular diet

The **soft low fiber diet** is defined as "a diet modified in consistency, that is, including liquid foods and those solid foods which contain a restricted amount of indigestible carbohydrate and connective tissue "* In planning the soft low fiber diet, a reduction in the amount of indigestible carbohydrate and connective tissue is of primary concern Indigestibe carbohydrates are known as cellulose, hemi cellulose, lignin, gums, pectins and mucin (see Chapter 3) These are found, for the most part, in the cell wall of plants

The indigestible carbohydrate of the normal diet may be reduced in many ways The use of refined breads and cereals thus excluding the whole grains and coarser cereals, is one modification The soft diet contains only cooked immature vegetables and fruits from which the seeds and skins have been removed This would include the elimination of jams and marmalades As indicated earlier, pectins and cellulose are disintegrated by cooking Further reduction of indigestible carbohydrate may be effected by puréeing fruits and vegetables If the purpose of the soft diet is not based on its reduction in fiber content but rather concerned with the fact that the patient cannot masticate easily, then the use of a blender to reduce the physical consistency of cooked fruits and vegetables may be warranted This often results in a more acceptable product than a purée

Connective tissue comprises the white or collagenous fibers and yellow elastic fibers called elastin which are found throughout the muscle tissue The amount of connective tissue found in any given cut of meat depends on the extent to which the muscle has been exercised and, to some degree, the age of the animal Generally speaking, the older animal has a higher percentage of connective tissue The relative tenderness of the meat is reflected

*Turner Dorothea Handbook of Diet Therapy University of Chicago Press p 19

in the amount of connective tissue present the less connective tissue the greater tenderness Moist cooking at low temperature converts the connective tissue to gelatin and thereby alters its consistency Meats may further be reduced in physical consistency by mincing or by scraping It is also possible to buy pureed meats—lamb beef, pork, veal liver and heart Each of these is a progressive step in the reduction of connective tissue in the soft diet

Because of the rejection of pureed foods by the patient the trend in recent years has been toward the more liberal use of tender meats refined cereals and cereal products and cooked whole skinless seedless immature fruits and vegetables Such a menu can easily be adapted from the normal diet both in the hospital and in the home

The **full liquid diet** is one that consists of foods that are liquid or that liquefy at body temperature In some cases the diet must be of a consistency to pass with ease through a drinking tube The liquid diet may also be further restricted to be only a **clear liquid diet** This supplies fluids but is of little importance nutritionally as it usually contains only calories The former the full liquid diet is the normal diet modified only in physical consistency and may be adequate nutritionally

The clear liquid diet consists of fat free broth tea coffee without milk or cream clear fruit juice or vegetable juice sugar gelatin and carbonated beverages Ices without milk jellied consomme and a combination of these foods may be included In some hospitals the clear liquid diet contains egg white in various forms such as whipped with gelatin and in fruit juices Obviously this regimen is nutritionally deficient and is used for only a short time

There is no need for monotony in the full liquid diet if ingenuity and care are exercised in its preparation The diet may be both palatable and adequate

Milk is the major source of the protein of high biological value Milk with slight padding could be made biologically adequate if it were not that the bulk necessary to meet caloric requirement would be too great However using milk as the foundation it is possible to build up varied diets For example 1 quart of milk plus 50 c c of 40% cream and 50 gm of lactose forms the ' milk cream lactose drink of Coleman which yields 1 000 calories

The protein level of milk may be increased by adding powdered skim or whole milk, protein milk, Casec (calcium caseinate), gelatin, or egg, or any of the new high protein products may be used

Milk drinks may be flavored in countless ways with chocolate, cocoa, vanilla, coffee, spices, molasses, etc Dark cane molasses supplies approximately 1 mg of iron per tablespoonful and is a source of vitamins B_2 and B_6 and pantothenic acid Preparations such as Cal C Tose (Hoffmann LaRoche), Dietene (The Dietene Company), Vitikon (Upjohn), and other similar preparations add variety, vitamins, and extra protein, vitamins, and minerals to milk drinks Powdered yeast makes a valuable addition to any drink, and, if carefully prepared, may not be unpalatable If Vegex, a yeast preparation, is added, or is used with any liquid, the drink will have a good store of the vitamin B complex

Powdered milk, either whole or skimmed makes a valuable and inexpensive padding for milk Roughly, 1 cup of the powdered milk added to a quart of the liquid milk results in a milk of double nutritive value Or 2 cups of the powdered milk may be added The resulting triple rich milk may also be used as such or be made into a variety of palatable drinks The use of a blender often improves the texture (and, in turn, the acceptability) of these drinks Various flavors, as indicated above, may be added

Water or milk thickened with cereal becomes a gruel Any cereal may be used—farina, oatmeal, rice, barley, corn, arrow root, etc Instead of using the usual ratio of cereal to liquid, as in the preparation of breakfast food, from one fourth to one third as much cereal to liquid is used, depending upon the consistency desired The usual amount of salt should be added The gruel may be made with whole milk, skim milk, water, whey (the lactalbumin in whey is digested with greater ease, see Milk), or with diluted or undiluted evaporated milk, depending on the food value desired Or the gruel may be merely breakfast cereal diluted to the correct consistency with any chosen liquid Smoothness temperature, consistency, and seasoning are of paramount importance The difference between cold, lumpy, unseasoned gruel and hot smooth well seasoned gruel is striking Straining is essential for smoothness Gruel may also be made by soaking any of the "cold" cereals or crackers in the proper

amount of hot liquid Gruels may be enriched with cream or butter, egg yolk or whole egg or grated cheese Combinations of cereals lend variety

Cream soups are gruels to which vegetables have been added They may be prepared by using a flour or cornstarch gruel as a base in order to avoid distinctive cereal flavor Such gruels are known as white or cream sauce Any cooked vegetable which has been pureed may be added Vegetables served to the family may be added to a white sauce to form a cream soup for an invalid's tray Strained vegetables prepared for infant feeding may be used in this way The caloric and nutritive values of cream soups may be adjusted by the type of milk used or by padding with cream or butter Mixtures of vegetables form delicious flavor combinations Clear vegetable juice especially with a few drops of lemon is usually well liked Powdered debittered yeast may be added if desired thus increasing the nutritive value

Fruit may be given as fruit juice and is refreshing enough to be well tolerated by most individuals It may be padded with lactose, egg or banana rubbed through a fine strainer and beaten into the juice Lactose in large amounts has a temporary laxative action but one tablespoonful to a glass of fruit juice is well tolerated Beta lactose is five times more soluble than the alpha form Gelatin may be dissolved in any fruit juice and thereby increase its protein value Such a drink must be served immediately to prevent thickening of the juice before ingestion

Carbonated drinks are refreshing and when cream ice cream or powdered milk is whipped in they have definite food value Tea and coffee may be allowed in moderation except in rare instances

Thus any caloric fat protein carbohydrate ketogenic antiketogenic level or acid base balance may be obtained in palatable attractive liquid diet which may be maintained indefinitely In making adjustments as to protein fat and carbohydrate levels or in padding it must be remembered that diarrhea may result from high lactose or large amounts of fat and that fermentation with gas and possible distention may result from excessive use of any sugar

Because of the increasing recognition of the value of a diet higher in protein than normal in many clinical conditions such

TA

BASIC DIET MODIFIED

FOODS	REGULAR		100 GM PROTEIN		LIGHT	
	AMOUNT	MODIFICATION	AMOUNT	MODIFICATION	AMOUNT	MODIFICATION
Milk—whole	2 cups	---	5 cups	---	2 cups	---
Egg	1	---	2	---	1	Not fried
Meat, poultry, fish, cheese	4 oz E P	---	7 oz E P	---	4 oz E.P	*Tender meats n fried*
Bread, cereal, whole grain—enriched	4 servings	---	4 servings	---	4 servings	- -
Potato—cooked	1 small	---	1 small	---	1 small	Not fried
Vegetable—green leafy, yellow	1 portion	---	1 portion	---	1 portion	Cooked, tender, lettuce only r vegetable
Vegetable—other	2 portions	---	2 portions	---	2 portions	Tomato raw, cooked or pur vegetables
Fruit—citrus	4 fl oz or 1 av portion	---	4 fl oz or 1 av portion	---	4 fl oz or 1 av portion	Only grapefrui orange, or fr juice
Fruit—other	2 average portions	---	2 average portions	---	2 average portions	Canned, cooked without skins banana
Butter, fortified margarine, oils	3 tbsp	---	3 tbsp	---	3 tbsp	-
Soups	*Any*	---	*Any*	---	*Any*	*Clear or cream* soup, not spi
*Sweets**	*Any*	--	*Any*	---	*Any*	*Omit jam,* marn lade, or candy with fruit, nu
Dessert	*2 servings*	---	*2 servings*	---	*2 servings*	Omit doughnut pastries
Miscellaneous†	Any	---	Any	---	Any	Omit relishes, n spices

E P —Edible portion
*Candy jam jelly sugar honey, syrups molasses
†*Gravy spices relishes herbs nuts carbonated beverage*

as surgery, some chronic illness, and subnutritional states, many hospitals are including a "high protein diet" as part of the standard diet regimen The extent to which protein is added to the normal diet varies with the institution In some cases a 100 gm protein diet is considered "high," while in others 250 gm of protein is a "high protein diet" *This affords an illustration* of the importance of proper nomenclature Using the standard

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STANDARD HOUSE DIET

SOFT		FULL LIQUID		CLEAR LIQUID	
AMOUNT	MODIFICATION	AMOUNT	MODIFICATION	AMOUNT	MODIFI
cups	--	3 cups	1 quart powdered		-
1	Not fried	1 or 2	Raw in beverage or in thin custard		
4 oz EP	Tender meats pureed meats not fried	2 oz or more	Homogenized only		
4 servings	Refined only	4 servings	Gruel or strained farina		
1 small	Not fried omit skin	1 or more	Purée in soup		
1 portion	Cooked tender or purée	1 or more	Purée in soup		
2 portions	Cooked tender or purée	1 or more	Purée in soup juices		-
4 fl oz	Fruit juice	4 fl oz or more	Fruit juice (strained)	Any	Strained juice
2 average portions	Canned cooked without skins purée banana	2 or more portions	Fruit juice (strained)	Any	Strained
3 tbsp	Only butter margarine cream	3 or more tbsp	Only butter margarine cream		
Any	Clear or cream soup not spiced	Any	Only clear or cream soup	Any	Clear sou (broth lon)
Any	Omit jam marmalade or candy with fruit nuts	Any	Only sugar clear candy honey	Any	Only sug candy
2 servings	Omit doughnuts pastries cakes other than angel food and sponge	2 or more servings	Plain ice cream gelatin desserts thin custards rennet sherbet	2 or more servings	Only pla tin sh withou
Any	Omit relishes spices nuts popcorn	Any	Salt some spices carbonated beverage	Any	Salt car bevera

of 1.5 gm of protein per kilogram of body weight the high tein diet for the 25 year old reference woman of the Nat Research Council would consist of 82.5 gm Table 75 indi how the normal diet could be modified to supply 100 gm of tein Above 100 gm intake padding must be resorte Such padding can be both at mealtime and as the between drinks (See previous discussion)

A review of Chapters 5 and 6 will demonstrate that pr metabolism cannot be halted On a diet completely devoi

protein, nitrogen continues to appear in the urine, indicating utilization of body protein On experimental diets containing no protein, the protein equivalent of the urinary nitrogen (N × 6 25, since protein is approximately 16% nitrogen) indicates that the protein breakdown *amounts to 3 or 4% of the total caloric* production In the adult man, this is not far from 25 gm protein *daily It is evident, then, that protein deficiency can increase* rapidly in the face of increased need and inadequate supply

A number of high protein products, in addition to those previously mentioned, suitable for oral use have come onto the market Gerilac, Meritene and Dietene Accessory Feeding, etc Excellent suggestions for use accompany some products Countless other protein products are available which serve admirably for tube feeding, but flavor in many instances makes their normal oral administration difficult We have Aminoids Nutragest Protolysate, Essenamine, Somagen, Lactamin, Delcos Granules P H V, Protinal, and many others These are digests of various proteins, either one or of a combination (liver, yeast, casein, lactalbumin, wheat) They may be hydrolyzed (such products are known as hydrolysates) either by acid or enzymes They may or may not have carbohydrate, minerals, and vitamins added Careful reading of the label is essential They range in protein content from 15 to 75%—and in price up to $5 00 per pound Comparison of the label data with the composition of powdered skim milk at 25 to 30 cents a pound gives added emphasis to the value of powdered skim milk for oral use

Table 75 summarizes the discussion of the general or house diets That the normal diet can be modified in physical consistency to the 100 gm protein diet, the light diet, the soft low fiber diet, and to the full liquid diet and still retain its nutritional adequacy is demonstrated This table assumes that there is no indication that the basic diet needs to be modified in terms of flavor or amounts of specific nutrients

Modifications in Techniques of Service

Occasionally a patient is too ill to eat When this occurs, feeding measures must be *employed He may be fed intravenously* by blood **transfusions** Under certain conditions especially if there has been blood loss this is ideal at least as a beginning since it immediately provides all the essential nutrients, formed

elements and antibodies of the blood Transfusions are used frequently today and are of great value No longer are they considered as a last resort

Another method of feeding is by slowly injecting fluids subcutaneously or intramuscularly (**clysis** or hypodermoclysis) This is useful in supplying large amounts of liquid to patients who might otherwise become seriously dehydrated Physiological salt solution (0 7% approximately 1 teaspoonful to a pint of water) or glucose (2 to 5%) may be given in large amounts

Glucose in various concentrations of physiological salt solution can also be given directly into the vein (**intravenously**) By a slow continuous drip method it is possible to administer large quantities of fluid salt and glucose As high as 5 to 6 liters *may* be given in twenty four hours Since the percentage of glucose may be high several thousand carbohydrate calories may be supplied and may be lifesaving in starvation from acute illness Fluids should not be forced beyond 8 to 10% of body weight in twenty four hours Above this amount water intoxication will result with chills nausea vomiting sweating dizziness and even disorientation and convulsions

When glucose is administered members of the B complex incorporated in the solution facilitate its utilization and is considered the logical procedure The addition of ascorbic acid may be worth while

Protein can be administered satisfactorily either as a mixture of pure amino acids or as a protein digest A 5% amino acid 5% glucose solution is well tolerated Fats* also have been successfully administered by intravenous injection with the protein and glucose (See discussion of Parenteral Feeding)

The **tube feeding** is another form of the liquid diet By this method food in liquid form is introduced directly into the stomach through a tube from the mouth nose or an artificial opening in the gastrointestinal tract The food [illegible]

*Clark and Brunschwig report the daily use of a highly [illegible] a 17 day period (Proc Soc Exper Biol & Med 49 3 9 19[illegible] cubic centimeter finest [illegible] egg lecithin and added [illegible] through homogenizer [illegible] 10% dextrose 500 c c [illegible] emulsion were combine[illegible] at the rate of 500 c c.

More recently other investigators have been exp[illegible] jections and finding it may prove a feasible add[illegible] where high calorie intake is indicated (Nutr Rev [illegible]

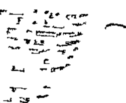


TABLE 76

CALCULATION OF A POSSIBLE TUBE FEEDING

		FOODSTUFFS				MINERALS		VITAMINS					
FOODS	AMOUNT	CALORIES	PROTEIN GM	FAT GM	CARBOHYDRATE GM	CALCIUM GM	IRON MG	VITAMIN A I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG	VITAMIN D I U
Milk—whole	5 cups	832	42.7	47.6	59.8	1.440	0.90	----	0.440	2.10	1.4	16	----
Nonfat dry milk solids	½ cup	217	21.3	0.6	31.2	0.780	0.35	----	0.210	1.17	0.7	4	----
Eggs—raw	2	154	12.2	11.0	0.6	0.052	2.60	1,100	0.100	0.28	----	----	----
Puréed raw beef liver	100 grams	136	19.7	3.2	6.0	0.007	6.60	43,900	0.260	3.33	13.7	31	45
Gruel—strained oat meal (baby)	*1 oz 13 Tbsp	111	4.6	2.2	18.2	0.141	0.15	----	0.570	0.14	1.4	----	----
Puréed peas	100 gm	49	4.1	0.3	7.9	0.016	0.14	630	0.090	0.08	1.1	8	----
Orange juice	8 oz	108	2.0	0.5	27.1	0.047	0.50	----	0.19	0.06	0.6	122	----
Cream—20%	2 cups	1,078	14.0	96.0	19.2	0.466	0.20	3,960	0.14	0.68	0.4	6	----
Sugar	¼ cup	192	----	----	49.0	----	----	----	----	----	----	----	----
Molasses	½ cup	413	----	----	106.0	0.270	7.1	----	0.230	0.210	0.8	----	----
Total		3,290	120.6	161.4	325.0	3.219	18.54	49,590	2.230	8.050	20.1	187	45

*Dry weight before cooking

will pass easily through the tube may be used. As shown in Table 76 a tube feeding may be nutritionally adequate and may be easily modified to meet the specific demands of the illness of the patient. It is a valuable method in feeding patients who are unable or unwilling to swallow.

A less effective method but one which may be resorted to is the **nutrient enema**. A 5 to 10% glucose is ordinarily used but little dependence can be placed upon the absorption of the sugar. Water however is absorbed.

The crystalline vitamins may be given intravenously or intramuscularly alone or in any solution, when deficiencies require immediate correction.

Except when an obstruction or throat or mouth injuries necessitate prolonged feeding the above mentioned types of feeding rarely are continued for long periods. Much more acceptable are the types of feeding discussed previously the range of standard hospital diets.

Keeping in mind that the goal of food service is either to maintain or to bring about good nutritional status of the individual the importance of an attractive and palatable tray is manifest. Anorexia usually accompanies illness. Appetite must often be tempted by small amounts of food served with utmost care. Colorful trays of attractive china and variations in color and texture of food will many times influence a patient to try to eat. Then the taste teasing quality of the food itself may tempt him to continue. Too much stress cannot be put on attractiveness of food and service. Nutrition must become an art as well as a science.

Review Questions

1. What is the present day concept of diet therapy as opposed to the older approach?
2. In what ways may the diet be modified in diet therapy? Give examples of each.
3. What are the suggested characteristics of good dietary nomenclature? Give examples of each.
4. What are the factors that may determine the nutritional requirements of the hospital patient?
5. How may the recommended dietary allowances of the National Research Council for the normal individual be used in diet therapy?
6. What are the standard hospital or house diets? How do they differ from the normal diet? Illustrate.

7 Which one of these diets (the standard or house diets) may be nutritionally adequate?
8 When a person is too ill to take nourishment by mouth, what means of feeding are available? How adequate are these methods? Illustrate
9 What factors should be stressed in the serving of any diet?

Suggested Projects

1 Examine your own menu On the basis of methods of evaluation presented elsewhere, suggest the need of modification of your diet in relation to diet therapy
2 From your own menu pattern, modify your diet in terms of physical consistency for each of the standard "house" diets discussed in this chapter
3 Plan a clear liquid diet for one day Calculate the nutrients it contains Evaluate your results with the nutritional needs of the normal individual
4 Calculate a tube feeding using foods other than those in Table 76 Can this be nutritionally adequate?

CHAPTER 28

THE DIET OF SURGICAL PATIENTS

Surgical procedures make heavy nutritional demands on the patient. It is advisable to correct malnutrition in depleted patients and to maintain a good nutritional state in well nourished individuals prior to surgery. Attention should be given to fluids, minerals, vitamins, glucose, and glycogen. Postoperative routine may vary considerably. Nutritional needs are high and may be met by diets modified in consistency and methods of feeding. In some cases, restriction of certain foodstuffs may be desirable.

In considering the dietary adjustments which should be made in the feeding of the surgical patient, it must be realized that no set rules can be laid down. Obviously, the type of surgery, the possible complicating clinical conditions, such as diabetes, nephritis and the general state of nutrition are all influencing factors. The operation may be minor, the patient may be in excellent health, and his probable convalescence may be short, or the individual may have suffered from his ailment over a period of weeks or months and may be in a state of extreme undernutrition and other disease conditions may complicate. The diet offered will be adjusted to the conditions present; in general it should be high in protein, carbohydrate, and vitamins.

Certain generalizations may, however, be made. Good nutrition is an asset and every effort should be made to preserve or attain this condition. The administration of an anesthetic is always accompanied by fluid loss and gastrointestinal disturbance, and both the anesthetic and the anticipation of an operation are likely to bring about psychic disturbances in varying degree which may be reflected in digestive disturbances. The degree of reaction may differ widely in various patients even though their general state of health may appear similar. This variation prohibits exact routine procedure and makes personalization of treatment necessary.

The preoperative treatment in general use today predisposes to more rapid recovery than did the older method. Drastic purg-

ing once depleted the body of water just at the time when maximum storage was desirable Withholding of food or a "light" diet likewise depleted the carbohydrate stores when they should have been at maximum

Today, unless there are complicating factors or unless the patient is in poor nutritional state, the preoperative diet need not be restricted except in cellulose content If the indigestible fiber content of the diet is kept low for the last thirty six hours before operation, the fecal mass will be reduced to a minimum at the time of operation, a condition resulting in the same general effect as the preoperative cathartic

Preoperatively, the fluid intake and carbohydrate should be as high as can be tolerated comfortably Carbohydrate has a protective action in combating the toxic effect of anesthesia It has been suggested recently that adequate protein reserves are very important in postoperative recovery Food should, if possible, be withheld sufficiently long to assure an empty stomach at the time the anesthetic is administered The usual procedure is no food after the evening meal for an operation scheduled the following morning If the operation is to be performed in the afternoon, a fluid breakfast is usually desirable

Frequently a debilitating sickness has preceded the surgical intervention This will necessitate careful preoperative preparation of the patient if he is to withstand the shock of operation and to make optimum recovery The diet should be carefully adjusted in the preparatory period so as to be high in protein minerals, and vitamins—a palatable, easily digested, concentrated diet, directed toward maximum nutritional response Anemia may complicate the condition and should receive specific consideration (see discussion of The Anemias) Also, if the patient is obese a reduction in weight may be part of the preoperative treatment Thus, today the nutritional status of the patient before an operation is considered important for both the surgical procedure and the postoperative recovery

There seems to be no set routine in the postoperative treatment of patients In some situations the patient is given a clear fluid diet, then a full fluid, followed by a soft diet, and when the attending physician deems desirable, he is returned to a regular house diet The length of time the patient remains on each diet

and the range of food allowed vary throughout the country. A description of each of these diets is found in Chapter 27.

Immediately following an operation attention is usually focused on the fluid, carbohydrate, protein, and calorie content of the patient's nutritional intake. The practice of hypodermoclysis begun before the patient recovers from the anesthetic has been a great boon from the standpoint of later comfort and also speed of recovery. Should the patient be in a state of undernutrition, however, supplying both liquid and glucose (supported by B vitamins) by parenteral routes as preoperative measures rather than the postoperative hypodermoclysis has proved more advantageous. The immediate postoperative treatment of the patient may include a combination of an intravenous fluid solution which may contain a varied amount of water, glucose, amino acids, minerals, and vitamins, blood transfusions, and later in the day a tube feeding. As indicated earlier, seldom is a routine procedure adapted for all patients. Frequently the nutritional status of the patient and the type of surgical procedure influence the postoperative nutritional treatment.

It has been suggested that proper attention to nutrition of the patient may reduce the time of convalescence. Many times the postoperative diets, reduced in consistency and changed in form to liquid and soft, are lower in nutrients than the Recommended Daily Allowances of the National Research Council for the well person. To date there have been no universally accepted standards of nutritive allowances for the postoperative patient. However, it is generally agreed that the nutritive needs of the postoperative patient are higher than those of the normal individual. Pollack and Halpern in *Therapeutic Nutrition* (National Research Council Bulletin No. 234) suggest that "the recommended daily allowances of nutrients for normal healthy people should probably be exceeded by about 100 per cent (except for calories) throughout convalescence with the protein intake especially kept high." Rhoads* also suggests that a 30 to 60% increase in protein requirement and a 25 to 30% increase in calorie requirement above the needs of the normal individual is in order for a mild operation. For an extensive operation he recommends almost twice that much.

*Rhoads, Jonathan D.: Dietary Requirements of Acutely Ill Patients. J. Am. Dietet. A. 29: 897, 903, 1953.

Thus, extreme care must be exercised in order *to avoid a* nutritional deficiency during the postoperative period The full fluid diet can be nutritionally adequate and it can be easily fortified so that a nutritional deficiency need not accrue from day to day

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If adjustment is necessary to meet specific conditions, such as diabetes or nephritis, careful planning will be required to avoid deficiencies

If the gastrointestinal tract is involved, the postoperative diet must subscribe to the dysfunction Gastrointestinal activity is then highly undesirable and rest is imperative In spite of the wish to re establish normal dietary routine as quickly as possible it is wiser to sacrifice nutrition by the usual methods in these patients for the sake of the local lesion It may be necessary to withhold food from twenty four hours to as long as several *days* During *this period nothing may* be given by mouth, however, vitamins, glucose, protein, minerals, fat, and fluids may be administered by hypodermoclysis or by the intravenous route (see Chapter 27) The time that elapses between operation and ingestion of food depends on the site and severity of the *lesion* An operation for removal of appendix or gall bladder may require abstinence from food for only eight to twenty four hours whereas *operations on the stomach,* intestine or colon may require much longer abstinence Diet is resumed with strained *fruit* juices ginger ale, broths etc followed by full fluid soft and

"house" diets Gas formation, roughage, foods that retard digestion, or those irritating in any way, are to be avoided It may be some time before the patient may resume his usual diet, and it is possible that his food may still be modified in some way, such as the restriction to a limited amount of some constituent or in the size of portions, and so on Maximum nourishment with minimum effort is the aim of the diet

Review Questions

1 What is the modern method of dieting the preoperative patient?
2 What food nutrients should be at a high level at the time of operation?
3 What diet is served to the patient after an uncomplicated operation?
4 What is the procedure after an operation involving the gastrointestinal tract?

Suggested Projects

1 Calculate a full fluid postoperative diet for a patient from any age group according to the recommendations set forth in this chapter How frequent would the feedings have to be to meet the nutritive requirements of the patient?
2 Calculate a soft postoperative diet for a patient from any age group according to the recommendations set forth in this chapter
3 Select a food culture pattern from among those described in Chapter 23 Plan a soft postoperative diet within the framework of this pattern that also meets the recommended nutritive level for the patient

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"house" diets Gas formation roughage foods that retard digestion or those irritating in any way, are to be avoided It may be some time before the patient may resume his usual diet, and it is possible that his food may still be modified in some way, such as the restriction to a limited amount of some constituent or in the size of portions and so on Maximum nourishment with minimum effort is the aim of the diet

Review Questions

1 What is the modern method of dieting the preoperative patient?
2 What food nutrients should be at a high level at the time of operation?
3 What diet is served to the patient after an uncomplicated operation?
4 What is the procedure after an operation involving the gastrointestinal tract?

Suggested Projects

1 Calculate a full fluid postoperative diet for a patient from any age group according to the recommendations set forth in this chapter How frequent would the feedings have to be to meet the nutritive requirements of the patient?
2 Calculate a soft postoperative diet for a patient from any age group according to the recommendations set forth in this chapter
3 Select a food culture pattern from among those described in Chapter 23 Plan a soft postoperative diet within the framework of this pattern that also meets the recommended nutritive level for the patient

Thus, extreme care must be exercised in order to avoid a nutritional deficiency during the postoperative period The full fluid diet can be nutritionally adequate and it can be easily fortified so that a nutritional deficiency need not accrue from day to day

One of the postoperative problems which the patient encounters is the accumulation of intestinal gases It has been pointed out that there are factors other than food which are responsible for this postoperative discomfort It has been observed by some that if solid foods are served soon after surgery, there is an early return to normal intestinal activity and less postoperative gaseous distention It has been pointed out by others that when the patient is on a liquid diet he admits a large amount of air during swallowing This contributes to the gaseous condition It is believed that liquid carbohydrates of high glucose content are important sources of distending gas It must be kept in mind however, that food is only one of the possible factors related to postoperative distention The trend, today, in the diet of surgical patients seems to be to resume a normal diet as soon as the patient has reached the point where it may be tolerated

If adjustment is necessary to meet specific conditions such as diabetes or nephritis, careful planning will be required to avoid deficiencies

If the gastrointestinal tract is involved, the postoperative diet must subscribe to the dysfunction Gastrointestinal activity is then highly undesirable and rest is imperative In spite of the wish to re establish normal dietary routine as quickly as possible, it is wiser to sacrifice nutrition by the usual methods in these patients for the sake of the local lesion It may be necessary to withhold food from twenty four hours to as long as several days During this period nothing may be given by mouth, however, vitamins, glucose, protein, minerals, fat, and fluids may be administered by hypodermoclysis or by the intravenous route (see Chapter 27) The time that elapses between operation and ingestion of food depends on the site and severity of the lesion An operation for removal of appendix or gall bladder may require abstinence from food for only eight to twenty four hours whereas operations on the stomach intestine or colon may require much longer abstinence Diet is resumed with strained fruit juices, ginger ale, broths, etc followed by full fluid soft and

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CHAPTER 29

FEVERS, BURNS, AND FRACTURES

When the febrile condition is acute the most important nutritional consideration is the correction of fluid and electrolyte balance along with as high protein and caloric intake as the patient can tolerate A chronic febrile condition requires specific individualized treatment In acute phases, the consistency of food may be modified to either a liquid or semiliquid diet Both fractures and burns may demand an increased amount of protein and calories The condition of the patient may present difficulties in feeding

While not directly related, febrile conditions, extensive burns, and fractures make great nutritional demands upon the patient The degree of these needs will vary with the specific condition The way in which these high nutritional requirements are met also varies with each patient However, it is possible to set forth some broad generalizations which may serve as a guide for the dietary treatment of these various conditions

Febrile Diseases

There are three primary factors that govern the nutritional requirements for a patient suffering from a febrile disease (1) an increase in metabolism, (2) an increased protein metabolism (usually a catabolic loss), and (3) a change in water balance These factors are considered in detail in the following discussion

Fever is caused by imbalance between heat production and heat elimination For every degree Centigrade increase in body temperature above normal, there is a 13% increase in metabolic rate Thus, a temperature elevation of 37° to 40° C will result in an increased caloric need of about 40% But other factors may be operative DuBois suggests that the requirement may be calculated by determining the normal metabolic rate according to age and sex, adding 13% for every degree of fever and 10% more if there is toxic destruction of body tissue, and then adding from 10 to 30% for the restlessness of the patient Thus, the increased need of a bed patient with fever may be as high as

60% above basal As has been said repeatedly, good nutrition is the goal in all conditions and it is essential in combating any disease Therefore the need for approximate caloric balance is apparent Thus the caloric allowance can be within the range of 3 000 calories

Protein metabolism is increased in fevers depending upon the grade of infection more than upon the hyperthermia (fever) and its resulting metabolic increase The breakdown of body protein due to the activity of toxic agents is spoken of as toxic destruction of protein The extent of the breakdown depends on the causative agent and the grade of infection (See discussion of high protein diets)

The protein intake should be sufficiently high to enable the patient to maintain nitrogen balance a condition signifying that body tissues are not being depleted Pollack and Halpern (*Therapeutic Nutrition* N R C Publication No 234) suggest that the allowance of 1 gram of protein per kilogram of body weight should be doubled in febrile disease of more than transient nature Others have expressed the doubt that all febrile patients can remain in nitrogen balance even though the protein intake is increased far above normal requirements

A diet sufficiently high in calories and in carbohydrates contributes toward the prevention of protein being used as fuel Carbohydrate more effectively spares protein than does fat it combats acidosis and is well tolerated Moreover carbohydrate stores (glycogen) are quickly exhausted The glucose of the blood is dependent upon the glycogen and is the most readily available source of energy Quantities of carbohydrate are therefore required to maintain the glycogen and blood glucose Wohl* suggests that the diet should contain carbohydrate equal to one fourth or one half the daily caloric need or from 220 to 420 grams

The fat level should be essentially normal in amount unless the caloric level is such that carbohydrate alone cannot supply the additional calories Egg yolk cream and milk with some butter are the preferred sources of fat

Because of excessive sweating and increased urinary excretion due to nitrogenous waste fever brings about a greater need

*Wohl Michael G Dietotherapy in Clinical Nutrition edited by Jolliffe Tisdale and Cannon.

for water It has been *suggested that the patient drink from* 3,000 to 3,500 c c of fluid per day

The salt intake (NaCl) is important inasmuch as more than normal amounts will be lost in perspiration Liquid diets will be low in sodium chloride unless care is taken to include salt containing foods, such as broths and soups It may be wise to add salt to all foods where it will not cause lack of palatability

The increase in metabolism brings about an increased need for vitamins Liquid and soft diets, which are frequently prescribed in febrile conditions, may be inadequate in the necessary vitamins The B complex and vitamin C are those that are especially needed It has been recommended that vitamin supplements be given in order to meet the increased requirements for these nutrients

The physical consistency of the diet, that is, liquid, soft, light or regular diet, depends upon the condition of the individual patient Regardless of the form of the diet, the nutritional requirements remain the same

In **acute febrile** illness, that is, when the condition is of short duration (approximately under one week), the primary considerations are to maintain an adequate fluid intake and to offer the *food which is most satisfactory to the patient If possible*, he should be encouraged to include fruit juices in the diet so that the carbohydrate may be available as a protein sparer However, in order to reduce the length of convalescence, to prevent malnutrition, and to forestall vitamin deficiencies, even in acute infections it seems advisable to provide a diet high in *nutritional* value Lack of appetite may hinder the ingestion of a desirable *diet by normal means, even though* the diet may be given in a liquid or semiliquid form Thus, a tube feeding may be necessary If the patient has been in an excellent nutritional state, his body stores may be able to meet the stress of a few days of acute infection Today we no longer "starve a fever," as it may lead to more severe illness *nutritional deficiencies*, and an extended convalescence

Chronic febrile conditions, ones that last approximately more than seven days, have high caloric and protein needs The number of calories required will depend upon the extent of fever Pollack and Halpern suggest that *in the absence of fever* approximately 2,500 to 3 000 calories are desirable They further

suggest about 150 gm. of protein daily to prevent protein depletion and to provide for growth and regeneration of diseased tissues. In addition, vitamin supplements are usually given. The diet usually progresses from liquid to soft low fiber foods depending upon the condition of the patient.

Typhoid fever is a general infectious disease with specific manifestations in the intestines, the early appearance of Peyer's patches with subsequent necrosis and ulceration. The most striking gross lesions appear in the small intestine. Liver and gall bladder changes follow.

Our knowledge of the importance of diet in fevers has been broadened by the work on typhoid fever carried out at the Russell Sage Institute. Experiments there indicated that a 23 to 44% metabolic increase exists in typhoid fever. The older type of diets which supplied from 300 to 500 calories daily, on the premise "starve a fever," resulted in such emaciation that convalescence was much hampered. The diets proposed by Shaffer and Coleman in 1908 and 1909 completely revolutionized the treatment of typhoid. Their diets were calculated to contain 3,000 to 5,000 calories daily. Protein destruction in this disease is about three times the "wear and tear" quota of health, and increase in protein intake must be provided to meet it. Roughly 1.5 to 2 gm. per kilogram will accomplish this if there is also an increase in calories and carbohydrate. Twice the normal calorie requirement will be adequate, or 60 to 80 calories per kilogram according to Coleman.

Coleman found that the duration of the disease was shortened, the diarrhea lessened, weight loss prevented, and hemorrhage and perforation less frequent, mortality decreased, and convalescence shortened by the use of a liberal, adequate dietary regime. Hemorrhage or perforation, however, of necessity demands immediate discontinuance of food. The diet is necessarily liquid at first, then semisolid until convalescence is complete. It must be devoid of indigestible cellulose. The usual feeding schedule in this disease is to administer food at two-hour intervals from morning until mid-evening, usually eight feedings of roughly 400 to 500 calories each. As the patient improves, the meals are adjusted to three main meals with three in-between meals as used frequently in diet therapy. The foregoing general suggestions for diets in febrile diseases also apply to typhoid fever.

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The salt intake (NaCl) is important inasmuch as more than normal amounts will be lost in perspiration Liquid diets will be low in sodium chloride unless care is taken to include salt containing foods, such as broths and soups It may be wise to add salt to all foods where it will not cause lack of palatability

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progress to a soft or a light diet The food should be simple easily digested and well prepared Inasmuch as tuberculosis is a disease of long duration and curtailed activity the diet must be adjusted to the patient s economic environmental and personal characteristics Contentment is of prime importance Lack of appetite is frequently a difficult complication

Pneumonia is an acute infection in which there is disturbance of chloride and nitrogen metabolism with lung involvement Metabolism may be increased as high as from 20 to 50% above normal Because the disease is of short duration the procedure suggested in the discussion of acute febrile diseases is applicable in pneumonia The diet should be a palatable liquid diet given in small amounts at short intervals necessitating minimum exertion and disturbance Fifteen hundred to 2 000 calories will normally be sufficient Fruit juices supply vitamin C which is thought by some to have more than usual value in promoting resistance to the infection The necessity for lung rest and factors which affect respiratory exchange apply also to pneumonia

The distressing abdominal distention which sometimes occurs in pneumonia is not of dietary origin but probably is due to toxic paralysis of the intestine Increased salt intake is found by some to decrease the symptom During convalescence the diet is gradually changed from liquid to soft and then to the regular diet (as described in Chapter 27)

In **brucellosis** (undulant fever) (the mortality rate is from 2 to 5%) the patient suffers from a generalized aching headache anorexia chilliness insomnia backache and stiffness or pain in the joint The temperature may rise to between 104° and 105° F *As symptoms subside an extreme weakness occurs* The temperature increases in the afternoon and evening followed by drenching sweats The febrile phase lasts three days to six weeks which may recur after a few days of normal temperature The diet in this condition follows the general procedure set forth previously However it is modified according to the preference and the condition of the patient

In **scarlet fever** there is disturbance in the elimination of nitrogen and retention of sodium chloride according to DuBois Therefore milk and fruit juices are suggested as suitable low

Tuberculosis is a chronic long continued disease with little or no metabolic increase, according to McCann and Barr, except where temperature elevation occurs. Protein destruction is less intense than in other fevers, and since dynamic action is the same as in normal persons, the protein level should be the same as maintained in health if metabolic increase from dynamic action is to be prevented. Another factor to be kept in mind in tuberculosis is that protein and carbohydrate affect the volume of respiration to a greater extent than does fat. Since lung rest is imperative in pulmonary tuberculosis, modern dietary treatment consists of a *moderate protein and carbohydrate level and a high fat intake*, a regime much more to be preferred than the old milk-egg-lactose drinks with which the patients were formerly stuffed.

It has been reported that the tuberculous patient may suffer from a protein deficiency, a vitamin A deficiency, and an ascorbic acid deficiency. *These, of course, will be taken into consideration in the diet prescription.*

Although correction of malnutrition is indicated, *it is recognized today that obesity is not an asset in the tuberculous patient and rapid weight gain does not necessarily indicate clinical improvement.*

There is variation in the recommendations for protein in the diet for tuberculosis. McCann suggests that a diet containing 60 to 90 gm. of protein, 150 gm. of fat, and enough carbohydrate (about 200 gm.) to bring the caloric intake to 2,500 calories is sufficient for the average patient on bed rest. McLester and Darby propose a liberal though not excessive amount of protein from 1.5 to 1.75 gm. per kilogram of body weight, or from 100 to 125 gm. daily for the average patient. Getz reported that patients at bed rest, with no out-of-bed privileges were offered 120 gm. of protein or more per day. The food left on the tray was weighed and it was found that these patients consumed 90 gm. per day. Getz further recommended that the increased need for ascorbic acid and vitamin A be treated as a medical problem, that is, even though foods rich in these vitamins are included in the diet, it is difficult to provide the necessary amounts without additional supplementation.

The diet itself may follow the pattern common to all febrile conditions: liquid or semiliquid in the acute stage and then

One of the most major considerations in the treatment of burns is the amount of protein lost by the patient. This may take place in three ways: (1) the catabolic phase in which nonprotein nitrogen is found in the urine, due to metabolic disturbance, (2) there may be from 10 to 50 gm. of protein lost daily in the protein rich exudate of the injured area, and (3) from plasma protein which has infused the injured tissue. Again, the extent of the protein loss depends upon the severity of the burns.

Other nutritional losses which are equally serious are those of fluid, electrolyte, and vitamin. Anemia is frequently an additional problem. Fluids are lost through the exudate as well as some electrolytes, primarily sodium chloride. Even though the body may be dehydrated, edema might also occur. There is a decrease in blood volume and a disturbed electrolyte balance. It has been observed that large amounts of ascorbic acid may be given to the patient without additional excretion of this vitamin. Evidence indicates that the patient may also require increased amounts of thiamine, riboflavin, and nicotinamide after severe burns.

The treatment of burns is initially a medical one (especially if the patient is gravely injured) directed toward saving life, that is, the treatment of shock and prevention of infection. However, along with these measures are the correction of the fluid and the electrolyte balance by blood plasma, and other means. These procedures are of course beyond the scope of the current volume.

The principles of the dietary treatment are to replace the losses incurred, to reconstruct tissue and to maintain a state of good nutrition. Large amounts of protein are needed. It has been suggested that as much as 300 gm. per day might be required. In order to obtain maximum benefit from the ingested protein the calorie content of the diet should be adequate. Pollack and Halpern have estimated that as much as 3,500 to 5,000 calories may be indicated. If the patient is gravely ill, it may be impossible for him to ingest such large amounts of food by usual means. It may be necessary to encourage him to drink, if that is feasible, special liquid drinks high in both protein and calories. These may include protein concentrates and fat emulsions. If the patient is unable to ingest any food by mouth, perhaps a tube feeding may provide the necessary nutrients. It

protein foods in the acute stage, after which the usual plan of liquid diet, then soft diet, and on to the house diet and normal protein intake is instituted.

Rheumatic fever frequently occurs in patients who have been living on diets below accepted intake. It is important therefore to check this point and immediately correct the deficiencies. The deficiencies are listed as protein, vitamins A and D, calcium, phosphorus, and iron. High dosage of vitamin C has been advantageous according to some reports. Anorexia is a disturbing complication. The general rules for febrile conditions apply here. Should ACTH be given, sodium will need to be restricted.

Poliomyelitis, while not requiring dietary adjustments to the extent in other diseases, may need equally careful dietary planning. The condition has a period of acute fever followed by a long convalescence. Due to paralysis, swallowing may be difficult. Coordination may be impaired. Because of widespread cellular destruction, potassium is lost. Anorexia is a problem. Skill at its best must be used to overcome this and restore the patient to an intake of food suitable for growth and repair.

Whooping cough is frequently rather long drawn out, and malnutrition often becomes an unwanted complication. Loss of food in vomiting may be serious. Smaller, more frequent, and more concentrated meals of easily digested foods may prove helpful. Deficiencies must be guarded against. If food ingestion cannot be made adequate, commercial vitamin products and various means of padding may be employed.

In other febrile conditions the affected part and the patient's comfort serve as guides to necessary adjustments in the diet. Nursing care and special attention in the care of the mouth, which should be cleaned before and after feedings, will go far in encouraging the patient to eat adequately.

Burns

Diet therapy is important in the treatment of burns. The role nutrition plays is, of course, in proportion to the severity of the injury In many cases, feeding the patient by normal methods presents a difficult problem and other means, such as tube feedings and intravenous solutions, are necessarily employed

lem of patients with fracture of the jaw is the length of time devoted to eating A patient is easily discouraged, because of these many problems, from eating an adequate amount of food

Review Questions

1 What dietary adjustments are necessary in acute febrile conditions?
2 What causes hyperthermia?
3 To what extent does fever affect the metabolic rate?
4 Is the old saying "Stuff a cold and starve a fever" now tenable?
5 What attention should be paid to protein in the diet of a fever patient?
6 How and why is the carbohydrate in the diet affected?
7 How is the fat level affected? The water? Sodium chloride?
8 What specific dietary measures are required in typhoid fever?
9 How does the diet for tuberculosis differ from the normal diet?
10 What type of diet is advised in the acute stage of pneumonia? Scarlet fever?
11 What complications may ensue in whooping cough which affect the dietary regime?
12 How may the normal diet be modified in the treatment of burns? Why?
13 How may the normal diet be modified in the treatment of fractures of the long bones?
14 What are the complicating factors in the dietary treatment of the patient with a fracture of the jaw?

Suggested Projects

1 Plan a day's menu for a child suffering from a chronic febrile condition Consider all the factors necessary in feeding children (refer to Chapter 20)
2 Plan a day's menu for an adult man with fracture of the jaw Consider his nutritional needs and the consistency of the diet How long do you think it would take the patient to eat each meal?
3 Plan a day's menu for a girl 25 years old who is a tuberculous patient

may be found that vitamin supplementation will be needed to supply an adequate amount of vitamins to meet the increased requirements.

As indicated, preventing tissue depletion is essential to normal healing. Throughout convalescence, a high protein, high calorie diet is usually indicated in the treatment of patients with burns

Fracture

In some instances, patients with fractures do not receive special dietary attention though nutritional measures are often indicated. When a patient suffers a fracture of the long bones, there is evidence that there is an increase in protein catabolism, even in well-nourished individuals This nitrogen loss in the urine has been observed soon after fracture and, in many cases, nitrogen equilibrium has not been re-established for several weeks. There is also a loss of potassium, phosphorus, and sulfur. A calcium loss occurs especially when the patient is immobilize This loss cannot be met by giving the patient calcium. Ther may be a disturbed electrolyte and water balance.

As in other conditions, the nutrition of a patient with fracture is directed toward the replacement of losses plus a liberal supply of protein, calories, and vitamins and minerals. The specific amounts of these nutrients are determined by the condition of the individual patient. Pollack and Halpern suggest that about 150 gm. of protein per day and 3,000 nonprotein calories might be needed In addition, the fluid and electrolyte balance is corrected A high protein diet is believed to help with deposition of calcium in the bones Usually, it is possible to provide the patient with the necessary nutrients in the normal meal pattern with, perhaps, high protein-high calorie in-between feedings.

A difficulty arises in the dietary treatment of patients with fracture of the jaw. Usually the patient's jaws are wired so that he may open his lips but not his jaws. It is necessary that the food be of a consistency so that it may be held in the cheek and sucked through the spaces around the wired teeth The jaw may be wired from approximately three to six weeks The food, then, must be concentrated in calories and other nutrients and be of a gruellike consistency. To increase "taste appeal," there should be some item at each meal which is "clear," with a sharp, identifying flavor, such as a broth or tea. An additional prob-

and Best who were working in the laboratory of Dr J J R Macleod in Toronto They discovered that an extract of the islet cells (or islands of Langerhans) would when injected into a diabetic animal control the diabetes The Nobel Prize in Medicine for 1921 was the reward for this lifesaving contribution Dr John R Murlin to whom this book is dedicated was one of those contributing greatly to our knowledge of insulin and diabetes

Since the discovery and the clinical use of insulin diabetes has ceased to be the death dealing disease it was formerly The diabetic person is no longer an invalid No longer must he drastically restrict his food indulge in fast days or curtail his activities Insulin has given him a more liberal diet both in kind and in amount and he is now able to take his place in the economic world and in the world of pleasure

Three conditions bear the term diabetes renal diabetes diabetes insipidus and diabetes mellitus Renal diabetes refers to a condition in which there is an abnormal permeability of the kidney to glucose resulting in the lowering of the renal threshold and the consequent appearance of abnormal amounts of glucose in the urine It is questioned if the incidence of this condition is as great as was formerly believed Diabetes insipidus is an uncommon chronic condition in which enormous quantities of dilute urine are excreted daily (7 to 20 liters and sometimes more) due to pituitary dysfunction

Diabetes mellitus has been defined as a chronic disease of metabolism with heritable tendencies in which the body has lost its ability in varying extent to utilize glucose because of inadequate insulin production by the pancreas

The incidence of diabetes mellitus in the United States (the condition which is commonly called "diabetes) is estimated to be near 2 000 000 It is believed that there are many individuals who are undetected and therefore uncontrolled diabetics One of the programs in public health is directed toward the detection of these unknown diabetics Diabetes is found more often in women than in men and is highest between 50 and 64 years of age However it is often found in children and in young adults There is a *higher incidence among the urban than rural population*

CHAPTER 30

DIABETES MELLITUS

Diabetes mellitus is a disorder of carbohydrate metabolism which has progressed from a near fatal condition to a controlled disease in the twentieth century. Dietary management and the administration of insulin are the principal features in controlling diabetes. There are several dietary methods in use today. Insulin shock and diabetic coma are conditions resulting from uncontrolled diabetes. Education of the patient concerning his diet and simple laboratory tests are important in maintaining a "healthy" diabetic.

The disease diabetes mellitus has been known for centuries. The name is derived from the Greek words *diabetes*—to pour through—and *mellitus*—honey. Aretaeus, the Cappadocian, who lived about the first decade of the Christian Era, described two of the cardinal symptoms emaciation and excessive urination when he wrote that there was "melting of the flesh which flowed away in the urine." Chinese literature as early as the third century referred to the large volume of urine in diabetes "so sweet that it attracted the dogs," and on through the centuries references to the disease appear, with speculation and suggestion as to its cause and the therapy used. Hot and cold baths, wines, massage in the sun, whey and milk diets were used, as well as various types of medication.

In 1869 Langerhans showed that certain cells in the pancreas had a function other than the production of pancreatic juice. In 1889 Minkowski and von Mehring proved that the pancreas was concerned somewhat with diabetes, since removal of this organ from the dog resulted in diabetes. In 1901 Opie in America and Ssobolew in Russia proved that dysfunction of the cells which Langerhans had described, and which bear his name, resulted in diabetes, and that it was not a dysfunction of the pancreas as a whole.

Between 1869 and 1921 many brilliant experiments were performed which led finally to the discovery of insulin by Banting

regulating mechanism of the body This, in turn, may lead to an improvement in the ability to utilize glucose

It must be recognized that fats and proteins as well as carbohydrates contribute to glucose stores and subsequent carbohydrate metabolism within the body (see Chapter 6) In animals rendered diabetic by removal of the pancreas or by phlorhizin poisoning, it is possible to show that 58% of ingested protein, 10% of fats, and 100% of carbohydrates are converted to glucose Forty six per cent of the protein and 90% of the fats are converted to fatty acids Some amino acids may be converted either to glucose or to fatty acids (they are amphoteric) Therefore, the values for the amounts of carbohydrate and fat as ingested are not correct values for the total *glucose or fatty acid available to the body* To determine these latter values, calculation must be made as follows

Total available G* = 100% carbohydrate + 10% fat + 58% protein
Total available FA** = 90% fat + 46% protein
*G—glucose, **FA—fatty acid

Fat metabolism, as well as that of carbohydrate, is disturbed in diabetes The concept that "fat burns in the flame of carbohydrate" is no longer accepted As was indicated in Chapter 6, fatty acids (the end products of the digestion of fats) are carried to the liver and oxidized there to ketone bodies namely, beta hydroxybutyric acid, acetoacetic acid and acetone These ketone bodies are then sent to the cells where they are further oxidized for energy Normally this proceeds in an orderly fashion However when the utilization of glucose for energy is *limited by an insufficient amount of insulin* (as in diabetes), the body calls upon its second source of energy, the fatty acids Up to a certain point fat metabolism is complete and there are no excess ketone bodies As the mobilization and oxidation of fat is increased to meet this emergency the mechanism for complete oxidation in the cells does not proceed at a rate rapid enough to be able to keep up with the ketone bodies from the liver Thus, a condition known as ketosis or acidosis occurs The ketone bodies a result of incomplete fat metabolism, are excreted in the urine (ketonuria) If this condition is not treated, the concentration of ketone bodies in the blood may be so high as to cause coma and ultimately death

The cause of diabetes is unknown. However, there are several factors which are frequently associated with diabetes. One of the primary factors is heredity. It has been shown that the condition is inherited as a Mendelian recessive characteristic. There is a variation within the prediction of diabetes in the children, in the combinations of marriage of diabetics, and carriers. However, it has been predicted that if a diabetic person marries a nondiabetic person, that is, an individual who is neither a carrier nor a diabetic, none of their children will have diabetes of heritable origin.

A second predisposing factor in diabetes is obesity. Studies have shown that a large percentage of known adult diabetics have been obese. However, a small percentage of the obese develop diabetes. The relationship between obesity and diabetes is unknown, but it is recognized as a predisposing factor.

A third factor which is often mentioned is nervous influences. This finds support in the fact that diabetes occurs more often in mental workers than in manual. Also it is frequently found among those individuals who have ample food and leisure as contrasted to those who must work hard to have an adequate supply of food on the family table.

Although these predisposing factors are recognized, and, in some instances, steps can be taken to prevent the possible development of diabetes, the actual cause of this condition remains unknown.

As indicated previously, metabolism in the diabetic individual is disturbed. The generally accepted concept is that the utilization of carbohydrate is limited because of lack of endogenous insulin. This results in an increased blood sugar, which ultimately reaches the renal threshold level. The unutilized sugar above the renal threshold is excreted in the urine. The renal threshold varies from patient to patient. Apart from a diminished capacity to oxidize glucose in the cell, the body's capacity for storing carbohydrate, that is, the conversion from glucose to adipose tissue, is disturbed. However, the diabetic seems to be able to store some carbohydrate to be released later for use. It has been observed that an increased amount of carbohydrate in the diet may be responsible for an improvement in the sugar-

regulating mechanism of the body This in turn may lead to an improvement in the ability to utilize gluocse

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Total available FA** = 90% fat + 46% protein

*G—glucose, **FA—fatty acid

Fat metabolism as well as that of carbohydrate is disturbed in diabetes The concept that fat burns in the flame of carbohydrate is no longer accepted As was indicated in Chapter 6 fatty acids (the end products of the digestion of fats) are carried to the liver and oxidized there to ketone bodies namely beta hydroxybutyric acid acetoacetic acid and acetone These ketone bodies are then sent to the cells where they are further oxidized for energy Normally this proceeds in an orderly fashion However when the utilization of glucose for energy is limited by an insufficient amount of insulin (as in diabetes) the body calls upon its second source of energy the fatty acids Up to a certain point fat metabolism is complete *and there are no excess ketone bodies As the mobilization and* oxidation of fat is increased to meet this emergency the mechanism for complete oxidation in the cells does not proceed at a rate rapid enough to be able to keep up with the ketone bodies from the liver Thus a condition known as ketosis or acidosis occurs The ketone bodies a result of incomplete fat metabolism are excreted in the urine (ketonuria) If this condition is not treated the concentration of ketone bodies in the blood may be so high as to cause coma and ultimately death

Apart from the relationship of protein metabolism to total available glucose and total available fatty acid, it is important that the diabetic patient receive an adequate amount of protein daily His needs are no different from those of the normal individual

Thus in diabetes, total metabolism is disturbed Other organs are involved as well as the pancreas Those primarily affected are the liver and the adrenal, however, whenever any single gland is disturbed, the fine balance among all glands is affected A discussion, however, of such disorders, other than a brief review of carbohydrate, fat, and protein metabolism is beyond the scope of the present volume

Many of the classic **symptoms** of diabetes arise as a result of the metabolic disorders previously mentioned *Polyuria*, with its consequent *polydipsia* (extreme thirst), is the body's method of secreting excess glucose A constant feeling of hunger (*polyphagia*) and a feeling of weakness and lassitude can be the response to the unutilized glucose The uncontrolled diabetic has been described as a starved person, as part of his food is not available for energy purposes He often complains of rapid *weight loss* Many diabetics do not exhibit all of these symptoms, some may have only one or two, and the most common has been the complaint of *general weakness* It must be remembered that few patients are completely diabetic, most produce some endogenous insulin

One of the methods frequently used in the recognition of diabetes is the **glucose tolerance test** Ideally, the patient receives a diet for three days prior to the test which contains a constant amount of carbohydrate, usually 300 gm The fasting patient is given 100 to 150 gm of dextrose, usually in the form of lemonade as the first meal in the day An initial blood sugar level the fasting blood sugar, and one at a 1 hour and a 2 hour interval indicate the degree of utilization of the glucose Fasting blood normally contains about 100 mg of glucose per 100 c c of blood (It may range from approximately 80 to 120 mg) The normal individual will begin with a level not to exceed 140 mg per 100 c c , at the end of an hour it may be 160 but by the end of two hours it should be nearly back to normal In impaired carbohydrate utilization the beginning level is higher the peak higher

and the fall much slower (See Fig 64 for a comparison of various glucose tolerance curves) At a blood level between 150 and 200 mg glucose per 100 c c of blood, the renal threshold is reached, the kidneys can no longer reabsorb the excess sugar, and it spills into the urine Several factors may influence the glucose tolerance, one, the patient's emotional state There are other forms of a glucose tolerance test, such as variations in the amount of glucose administered, the way in which the patient ingests carbohydrate, the giving, in some cases, of a calculated and weighed meal consisting of protein fat and carbohydrate, and the intervals at which blood samples are taken The basic steps in procedure outlined, however, apply to all glucose tolerance tests

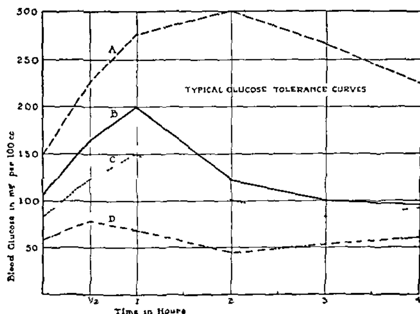


Fig 64 —Typical glucose tolerance curves A Diabetes mellitus B hyperthyroidism C normal D Addison's disease or hypothyroidism or hyperinsulinism (From Andes J E and Eaton A G Synopsis of Applied Pathological Chemistry St Louis 1941 The C V Mosby Co)

The present fundamental concept in the treatment of diabetes is to administer enough exogenous insulin which, coupled with the patient's endogenous production, will allow the utilization of available glucose By correcting the carbohydrate metabolism protein and fat metabolism can proceed normally The patient may consume a regulated adequate diet of normal foods There

is no other effective treatment for diabetes except insulin by injection, although many misleading advertisements to the contrary have appeared

There are several types of insulin available which will be mentioned briefly as there are variations in the length of time which they remain effective This, in turn, affects the available carbohydrate distribution in the diet **Regular insulin** is effective for a few hours If it is used exclusively, injections are given before each meal and food must follow within half an hour **Protamine zinc insulin** is more slowly absorbed and exerts its influence over a twenty four hour period If a patient uses protamine zinc insulin, he must be sure to include an evening, or "night" as it is sometimes called, feeding in his meal plan **Crystalline insulin** is similar to the regular insulin but is protein free and is slower in its absorption than regular insulin **Globin insulin** is midway

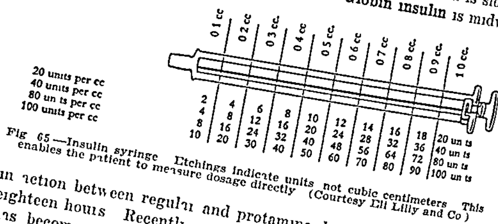


Fig 65 —Insulin syringe Etchings indicate units not cubic centimeters This enables the patient to measure dosage directly (Courtesy Eli Lilly and Co)

in action between regular and protamine, lasting approximately eighteen hours Recently, a **modified protamine insulin NPH 50** has become available This type is relatively quick in actio[n] and has an influence of approximately twenty eight hours I[t] has been observed by many that a mixture of regular and protamine zinc insulin or the new modified protamine insulin is used in a majority of cases However, many older diabetics and others who have found the regular insulin satisfactory still use this type The kind of insulin and the amount is of course a medical prescription

One unit of insulin will bring about the oxidation of 1 to 3 gm of carbohydrate A standard unit determined by bio assay, is used to express the strength of insulin Clinically, it may be obtained in several strengths, 10, 20, 40, 80, and 100 units per

cubic centimeter of solution The insulin dosage may need adjustment as the result of certain uncontrollable factors Duncan lists those requiring insulin increase as weight gain increased food intake decrease in activity pregnancy certain therapies (thyroid pituitary, deep roentgen ray dinitrophenol epinephrine) toxemias acute infections fever ketosis and ultraviolet ray burn It must be recognized that increased exercise in the diabetic will decrease the need for exogenous insulin as exercise stimulates the production of the diabetic s own insulin (endogenous)

The **diet** of the diabetic is based on the nutritional needs of the patient as an individual The Recommended Daily Allowances of the National Research Council (see Chapter 2) should serve as a guide If the patient is an elderly adult or if he is an adolescent his nutritional needs are the same as the normal elderly adult or adolescent The diet regime of the patient should be individual It should be flexible enough so that the patient can easily adjust to minor changes in his daily routine The diet should be adaptable to the patient s cultural food pattern and his economic situation In short it should meet all factors that were discussed in detail in Chapter 26

The total caloric intake needed should be determined by the patient's ideal weight If overweight it is recommended by most that the patient reduce It has been suggested that the adult diabetic is best at approximately 10% below his ideal weight The recommended amount of protein usually from 1 0 to 1 5 gm per kilogram for the adult and from 2 0 to 3 0 gm per kilogram for children should be included each day The carbohydrate and fat levels of the diet are set by the type of diet that is preferred that is either a high carbohydrate diet or a high fat diet It has been recommended however that the ratio of available carbohydrate to available fatty acid be approximately 2 to 1 Thus the carbohydrate and fat prescription would be adjusted to meet the total caloric need of the patient Translated into percentage of the total calories (see Chapter 24) protein supplies 10 to 20% of the total calories in the diabetic diet fat from 40 to 50% and carbohydrate from 30 to 40% An *approximate* rate might be 20 40 40 for protein fat carbohydrate calories *There is no level which is absolute*

The ratio between the three nutrients is one of personal desirability, within reasonable limits, just so long as it can be made clinically effective. Such leeway is possible by the "exchange" method.

The caloric distribution in the normal diet, it will be recalled, is 10 to 15% protein, 25 to 40% fat, and 40 to 50% carbohydrate. The food itself should be distributed throughout the day. McLester and Darby suggest that the morning meal should be light and the heavier meal at midday. As mentioned previously, a light meal, carrying approximately 20 gm. of carbohydrate, is needed at bedtime when the patient is taking protamine zinc insulin. This is done in order to prevent an insulin reaction during the night. The diet prescription, following the procedure mentioned above as well as guided by the knowledge and experience of the physician, is sent to the dietitian, nutritionist, or nurse as a specific number of grams of protein, fat, and carbohydrate.

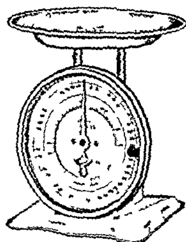


Fig. 66.—Scales for weighing food. (Courtesy Pelouze Manufacturing Co., Chicago.)

The translation of the diet prescription into foods has passed through a variety of stages in the past thirty odd years. At first the individual foods were rigidly calculated and the patients allowed little freedom of choice. The patients were told to weigh all foods (see Fig. 66). Today it is considered desirable to begin the diet with weighed portions if possible in order for the diabetic to become accustomed to accurate portions. Some physicians recommend that the patient always

weigh his food However this severely limits the patient s ac tivities forces him to eat at home always and has a depressing psychological effect It was recognized that there are wide vari ations in the carbohydrate fat and protein content of foods variations due to season variety age and quality of the item These were discussed in earlier chapters On the basis of this many lists of food equivalents were prepared and successfully used The widely accepted tables of 3 6 9 12 15 and 18% carbohydrate containing vegetables and the classifications of lean medium fat and fat meats are examples of such lists of equivalents These methods however still restricted the pa tient and required a great deal of unnecessary and often inaccu rate calculation on the part of the physician dietitian nurse or nutritionist

In 1947 a Joint Committee of the American Diabetic Associa tion the American Dietetic Association and the Diabetes Sec tion of the United States Public Health Service met as a nation wide effort was made to simplify and standardize a type of dietary treatment It has long been recognized that there were many current problems relative to the dietary treatment of the diabetic patient The following problems were listed in a re port by the committee*

1 Wide variability in food composition results in wide differences in figures used in computing
2 Methods used to estimate the composition of a diet may be prolonged and needlessly precise
3 Among clinical workers there are many inconsistencies in the in clusion or restriction of foods
4 Sizes of recommended portions may be stated in impractical amounts which are difficult for the patient to measure
5 Often the instructions to the patient are inadequate in content par ticularly where insufficient time is spent in discussing the diet
6 In many instances the diets are not adjusted to the food habits of the individual or so arranged that the patient will know how to plan his diet to fit different situations such as restaurant meals or packed lunches

To solve these problems then the Joint Committee recognized that its primary purpose was to develop diabetic diet material that would be easy to present to the patient and yet flexible enough that it could be readily adapted to individual food habits

*Caso Calculation of Diabetic Diets J Am Dietet A 26 575 [illegible]

Through the use of this material, it was hoped that many inconsistencies and inaccuracies in diabetic diets would be overcome. Such standardization was believed to be of benefit to professional personnel as well as to the diabetic patient. Late in 1949 the Joint Committee released the material which was incorporated into the booklet *Meal Planning and Exchange List*. Because of the excellence of the material itself and because of the endorsement by these three major professional organizations this plan has enjoyed increasing popularity and acceptability.

All foods allowed the diabetic are grouped into six exchange groups. Each exchange group has carbohydrate, fat, and protein value (depending upon the composition of the food within each group). Table 77 contains the composition of food exchanges and the respective carbohydrate, fat, and protein value. Tables 78, 79, 80, 81, 82, and 83 list each exchange individually and the foods included in that exchange. These tables of six exchanges are part of the educational material given to the patient. There are many foods that contain little or no carbohydrate, protein, and fat. By allowing an unrestricted amount of these foods the satiety value of the diet can be enhanced and the morale of the patient can be improved. Such foods are included in Table 84.

TABLE 77**

COMPOSITION OF FOOD EXCHANGES

LIST	FOOD	MEASURE	GM	C	P	F	CAL
1	Milk exchanges	½ pint	240	12	8	10	170
2A	Vegetable exchanges	As desired	—	—	—	—	—
2B	Vegetable exchanges	½ cup	100	7	2	—	36
3	Fruit exchanges	Varies	—	10	—	—	40
4	Bread exchanges	Varies	—	15	2	—	68
5	Meat exchanges	1 oz	30	—	7	5	73
6	Fat exchanges	1 tsp	5	—	—	5	45

TABLE 78**

LIST 1. MILK EXCHANGES

Carbohydrate—12 gm, Protein—8 gm, Fat—10 gm, Calories—170

	MEASURE	GM
*Milk whole	1 cup	240
Milk evaporated	½ cup	120
*Milk powdered	¼ cup	35
*Buttermilk	1 cup	240

*Add 2 fat exchanges if fat free

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TABLE 79**

LIST 2 VEGETABLE EXCHANGES

A These vegetables may be used as desired in ordinary amounts Carbohydrates and calories negligible

Asparagus	*"Greens"*	Lettuce
Broccoli		Mushrooms
Brussels sprouts	Beet	Okra
Cabbage	Chard	Pepper
Cauliflower	Collard	Radishes
Celery	Dandelion	Rhubarb
Chicory	Kale	Sauerkraut
Cucumbers	Mustard	String beans, young
Escarole	Spinach	Summer squash
Eggplant	Turnip	Tomatoes

B Vegetables 1 serving equals ½ cup equals 100 gm
Carbohydrate—7 gm , Protein—2 gm , Calories—36

Beets	Peas green	Squash, winter
Carrots	Pumpkin	Turnip
Onions	Rutabaga	

TABLE 80**

LIST 3 FRUIT EXCHANGES

Carbohydrate—10 gm , Calories—40

	MEASURE	GM
Apple	1 small (2 in diam)	80
Applesauce	½ cup	100
Apricots fresh	2 medium	100
Apricots, dried	4 halves	20
Banana	½ small	50
Berries straw , rasp , black	1 cup	150
Blueberries	⅔ cup	100
Cantaloupe	¼ (6 in diam)	200
Cherries	10 large	75
Dates	2	15
Figs, fresh	2 large	50
Figs, dried	1 small	15
Grapefruit	½ small	125
Grapefruit juice	½ cup	100
Grapes	12	75
Grape juice	¼ cup	60
Honeydew melon	⅛ (7 in diam)	150
Mango	½ small	70
Orange	1 small	100
Orange juice	½ cup	100
Papaya	⅓ medium	100
Peach	1 medium	100
Pear	1 small	100
Pineapple	½ cup	80
Pineapple juice	⅓ cup	80
Plums	2 medium	100
Prunes, dried	2 medium	25
Raisins	2 Tbsp	15
Tangerine	1 large	100
Watermelon	1 cup	175

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TABLE 81**

LIST 4 BREAD EXCHANGES

Carbohydrate—15 gm, Protein—2 gm, Calories—68

	MEASURE	GM
Bread	1 slice	25
Biscuit, roll	1 (2 in diam)	35
Muffin	1 (2 in diam)	35
Corn bread	1 (1½ in cube)	35
Flour	2½ Tbsp	20
Cereal, cooked	½ cup	100
Cereal, dry (flake and puffed)	¾ cup	20
Rice, grits, cooked	½ cup	100
Spaghetti, noodles, etc, cooked	½ cup	100
Crackers, graham (2½ in sq)	2	20
Oyster	20 (½ cup)	20
Saltines (2 in sq)	5	20
Soda (2½ in sq)	3	20
Round, thin (1½ in diam)	6 8	20
Vegetables		
Beans and peas, dried, cooked (Lima, navy, split pea, cow peas, etc)	½ cup	90
Baked beans, no pork	¼ cup	50
Corn	⅓ cup	80
Parsnips	⅔ cup	125
Potatoes, white, baked, boiled	1 (2 in diam)	100
Potatoes, white, mashed	½ cup	100
Potatoes, sweet, or yams	¼ cup	50
Sponge cake, plain	1 (1½ in cube)	25
Ice cream (omit 2 fat exchanges)	½ cup	70

TABLE 82**

LIST 5 MEAT EXCHANGES

Protein—7 gm, Fat—5 gm, Calories—73

	MEASURE	GM
Meat and poultry (med fat) (beef, lamb pork, liver, chicken, etc)	1 oz	30
Cold cuts (4½ in sq, ⅛ in thick)	1 slice	45
Frankfurter	1 (8 9/lb)	50
Fish cod, mackerel, etc	1 oz	30
Salmon, tuna, crab	¼ cup	30
Oysters shrimp, clams	5 small	45
Sardines	3 medium	30
Cheese cheddar, American	1 oz	30
Cottage	¼ cup	45
Egg	1	50
Peanut butter*	2 Tbsp	30

*Limit use or adjust carbohydrate

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TABLE 83**

LIST 6. FAT EXCHANGES

Fat—5 gm Calories—45

	MEASURE	GM
Butter or margarine	1 tsp	5
Bacon, crisp	1 slice	10
Cream, light 20%	2 Tbsp	30
Cream, heavy 40%	1 Tbsp	15
Cream cheese	1 Tbsp	15
French dressing	1 Tbsp	15
Mayonnaise	1 tsp	5
Oil or cooking fat	1 tsp	5
Nuts	6 small	10
Olives	5 small	50
Avocado	1/8 (4 in. diam.)	25

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TABLE 84

FOODS ALLOWED AS DESIRED

Negligible Carbohydrate, Protein and Fat

Coffee	Rhubarb
Tea	Mustard
Clear broth	Pickle, sour
Bouillon	Pickle, dill—unsweetened
Gelatin, unsweetened	Saccharine
Rennet tablets	Pepper
Cranberries	Spices
Lemon	Vinegar

Specialty or diabetic foods are not recommended. Such foods are costly and unnecessary because they change the "adjusted" food intake to a special diet. The diabetic foods are essentially starch free (gluten bread) or sugar free. Gluten (a protein) must be considered as 50% sugar and therefore cannot be eaten at will. Except where saccharine or other artificial sweeteners are desired, the diabetic person is wiser to acquire a taste for less sweet foods or drinks.

By using the values listed in Table 77, it is simple to adjust the patient's diet prescription to his usual meal pattern. As pointed out in the committee report, nutritive adequacy of the diet will be assured by including the same basic protective foods that are recommended for the normal individual. These include:

Milk	1 pint for adults 1 quart for children
Meat, fish, poultry, eggs, and cheese	4 to 5 oz
Whole grain or enriched cereal or bread	To meet calorie needs
Fruit—one a citrus fruit or tomato	2 servings
Vegetables—one green or yellow	2 servings
Butter or fortified margarine	To meet calorie needs

The procedure for calculating a diabetic diet is described in the report of the joint committee and reprinted below

*Procedure for Calculating Diabetic Diet**
Sample Prescription

Carbohydrate	180 gm
Protein	80 gm
Fat	70 gm.
Calories	1,700

	Amount	*Carbohydrate gm*	*Protein gm*	*Fat gm*
Milk, whole (List 1)	1 pint	24	16	20
Vegetables (List 2, group A)	As desired	—	—	—
Vegetables (List 2, group B)	1 serving	7	2	—
Fruit (List 3)	3 servings	30		
Total carbohydrate from sources other than bread exchanges		61		
180 gm carbohydrate in prescription − 61 gm from sources other than bread exchanges 119 ÷ 15 = 8 bread exchanges				
Bread exchanges (List 4)	8 servings	120	16	
Total protein from sources other than meat exchanges			34	
80 gram protein in prescription −34 gram from sources other than meat exchanges 46 ÷ 7 = 7 meat exchanges				
Meat exchanges (List 5)	7 servings		49	35
Total fat from sources other than fat exchange				55
70 gm fat in prescription −55 gm from sources other than fat exchanges 15 gm ÷ 5 = 3 fat exchanges				
Fat exchanges (List 6)	3 servings			15
		181	83	70

To determine the number of servings of bread, meat, and fat exchanges re quired to complete the diet prescription, it is necessary only to

(a) Subtract the number of grams of carbohydrate (61 in the example above furnished by the other sources of carbohydrate from the amount prescribed (180) and divide the result by 15 the number of grams of carbohydrate in one serving of bread exchange as noted in List 4

(b) The amount of protein in the diet may be adjusted to the pre scription by subtracting the number of grams of protein (34 in the example) supplied by milk, vegetables and bread exchanges from the amount prescribed (80) and dividing the remainder by 7, the amount of protein in each meat exchange

(c) Follow the same procedure with regard to fat, except to divide the result by 5, the number of grams of fat in one serving as noted in List 6

*Caso Calculation of Diabetic Diets J Am Dietet A. 26 579 1950

From a practical standpoint, it is unwise to calculate half exchanges Such portions become difficult for the patient to obtain It was recommended that the carbohydrate may vary as much as 7 gm from the amount ordered and the protein may differ by 3 gm As the fat exchange is 5 gm, it will probably be easy to meet The division of the exchanges into meals is governed by those factors discussed earlier in the chapter

The Joint Committee also prepared six sample meal plans which vary in composition Meal Plan No 3 (Table 85) has been included with two sample menus to illustrate how the food for the day may be divided into a meal pattern, and further, how that meal pattern may be adjusted to various food habits

From the experience of those who have used the "new" diabetic exchange system enthusiastic endorsement comes from practically everyone They have found patients receptive as it allows them greater leeway in choice of food and easy adjustment to their surroundings From the professional standpoint it relieves the nutritionist of time consuming tedious calculations and provides her with more opportunity for patient education

A step further in liberation of the diabetic diet is the "unrestricted" or "*free*" diet which has come into use during the last several years This program has been tried for a dozen years in Europe The 'free" diet permits the patient to eat what and how much he pleases "*within reasonable limits*" with adequate insulin coverage In order to prevent hypoglycemic shocks there needs to be a fairly continuous glycosuria This condition the supporters of this regime contend is not harmful Actually these diets are not wholly unrestricted The children on whom they have usually been tried have judicious supervision" of their food habits—first in the hospital and later in the home However they are permitted leeway in order to satisfy their own individual tastes Overindulgence is not permitted Freedom in choice is permitted only after the child has become familiar with the general principles of nutrition and diabetic control through instruction and initial ingestion of a prescribed measured diet Fairly regular food habits seem to be the rule in the studies so far carried out once the restrictions are lifted

At intervals during the year, the patient is asked to keep a week's record of his food intake This is analyzed by the di

The procedure for calculating a diabetic diet is described in the report of the joint committee and reprinted below

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119 ÷ 15 = 8 bread exchanges				
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Total protein from sources other than meat exchanges			34	
80 gram protein in prescription				
−34 gram from sources other than meat exchanges				
46 ÷ 7 = 7 meat exchanges				
Meat exchanges (List 5)	7 servings		49	35
Total fat from sources other than fat exchange				55
70 gm fat in prescription				
−55 gm from sources other than fat exchanges				
15 gm 5 = 3 fat exchanges				
Fat exchanges (List 6)	3 servings			15
		181	83	70

To determine the number of servings of bread, meat, and fat exchanges required to complete the diet prescription, it is necessary only to

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(b) The amount of protein in the diet may be adjusted to the prescription by subtracting the number of grams of protein (34 in the example) supplied by milk vegetables and bread exchanges from the amount prescribed (80) and dividing the remainder by 7, the amount of protein in each meat exchange

(c) Follow the same procedure with regard to fat, except to divide the result by 5, the number of grams of fat in one serving as noted in List 6

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At intervals during the year, the patient is asked to keep a week's record of his food intake This is analyzed by the di

TABLE 85**

For ________ AM DIETET A MEAL PLAN NO 3

Use only as your doctor prescribes
Carbohydrate 180 gm Protein 80 gm
Fat 80 gm Calories 1 800
This meal plan has been prepared to use with the Meal Planning Booklet

YOUR FOOD FOR THE DAY

Amount	Kind of Food	Choose from
1 pint	Milk	List 1
Any amt	Vegetable exchanges A	List 2A
1	Vegetable exchanges B	List 2B
3	Fruit exchanges	List 3
8	Bread exchanges	List 4
7	Meat exchanges	List 5
5	Fat exchanges	List 6

Divide this food as follows

YOUR MEAL PLAN

Breakfast

1 Fruit exchange from list 3
1 Meat exchange from List 5
2 Bread exchanges from List 4
2 Fat exchanges from List 6
Coffee or tea (any amount)

SAMPLE MENUS

These menus show some of the ways exchange lists can be used to vary the meal plan The exchange lists and recipes may be found in the Meal Planning Booklet

Breakfast

Orange juice ½ cup
Egg 1
Toast 2 slices
Butter 2 tsp
Coffee 2 Tbsp evaporated milk†

Lunch or Supper

Ham and cheese sandwich (cheese 1 ounce ham 1 ounce, bread 2 slices, butter 1 tsp)
Lettuce and tomato salad
Zero salad dressing (special recipe)
Apple 1 small
Milk 1 cup (8 ounces)
Coffee or tea

Dinner

Hamburg patties 3 ounces
Mashed potato ½ cup
Carrots ½ cup (special recipe)
Bread 1 slice butter 2 tsp
Banana ½ small
Coffee or tea

Breakfast

Prunes 2 medium
Cereal cooked 1/ cup
Milk ¼ cup (2 ounces)‡
Poached egg (1) on toast 1 slice
Butter 1 tsp
Coffee 2 Tbsp light cream

Lunch or Supper

Bologna 2 slices
Radishes celery, sour pickles
Potato salad (A) ½ cup
Bread 1 slice butter 1 tsp
Grapefruit ½
Milk 1 cup (8 ounces)
Coffee or tea

Dinner

Tomato juice small glass
Roast lamb 3 ounces
Steamed rice ½ cup
Green peas ½ cup

Lunch or Supper

2 Meat exchanges *from List 5*
2 Bread exchanges from List 4
Vegetable from List 2A (any amount)
1 *Fruit exchange from List 3*
1 cup milk from List 1*
1 Fat exchange from List 6
Coffee or tea (any amount)

Dinner or Main Meal

3 Meat exchanges from List 5
2 Bread exchanges from List 4
Vegetable from List 2A (any amount)
1 *Vegetable exchange from* List 2B
1 Fruit exchange from List 3
2 Fat exchanges from List 6
Coffee or tea (any amount)

Bedtime

1 *cup milk from List 1**
2 Bread exchanges from List 4
1 Meat exchange from List 5

Bedtime

Milk ¾ cup (6 ounces)†
Peanut butter sandwich (peanut butter 2 Tbsp, bread 2 slices)

Mixed green salad
French dressing 1 Tsp
Bread 1 slice, butter 1 tsp
Pineapple gelatin (special recipe)
Coffee or tea

Bedtime

Milk ¾ cup (6 ounces)‡
Graham crackers 4
American cheese 1 ounce

*Part of milk may be used for coffee, tea, or for cereal
† Tbsp evaporated milk equals ¾ cup whole milk. Part of the milk is taken from bedtime to use at breakfast
‡Part of the milk is taken from bedtime to use at breakfast
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etitian and necessary adjustments or advice is given Urine tests for sugar and acetone are those followed by all diabetics

An added advantage is the increase in food intake following exercise, which compensates for the lowered blood sugar at such time This is important for active children

The major advantage, however, is psychological Most individuals are happier with a minimum of restriction and rules There is less worry and nagging on the part of the mother of a diabetic child, less resentment and desire to cheat, with the feeling of guilt which accompanies such action It is an experiment well worth following With intelligent patients it would seem to have definite advantages As one physician put it patients who broke diet almost constantly, frequently got along "irritatingly" well Perhaps the strict control which has been practiced is not necessary

There are those clinicians, however, who strongly object to the use of the "free" diet Marble pointed out that those patients whose diabetic condition had been best controlled over years of time are those who show the least vascular damage He felt that present data indicate the importance of meticulously controlled diabetes and that "free" diets are to be discouraged White suggested that it seemed an advisable practice to have a controlled diet for the entire family instead of a "free" diet for the diabetic member Others have pointed out that the free plan which allowed a disturbed metabolic state, as hyperglycemia and glucosuria is not desirable The accepted means of treatment is directed toward maintenance of normal physiological conditions

After the diet is calculated the insulin dosage is adjusted in amount and distribution to assure normal utilization of carbohydrate as evidenced by a normal blood sugar level, an essentially negative urinary sugar (absence of glycosuria) and the absence of ketone bodies in the urine The dosage in units will equal approximately one half the number of grams of sugar excreted in the urine when no insulin is given Obviously careful adjustment must be made in the individual case just as dietary adjustment must be made to personalize the diet itself

The nutritional needs of the diabetic child are the same as those of a normal child and they should govern his diet prescription Diabetes in the child is the same as that in the adult but he

must be more closely watched The diabetic condition may be more severe and insulin shock is likely to occur There is a small range between hyperglycemia and hypoglycemia It is important to allow for the physiological demands of growth Education is particularly important so that both the child and his family understand the seriousness of his condition and their role in the control of diabetes

In **postoperative conditions** in diabetic patients it is simple to substitute a liquid diet for the usual diet Within the exchanges there are many liquid foods and many other foods that can be modified in consistency to a liquid or a bland diet All diabetics whether there has been surgical intervention or not should understand how to substitute liquid foods for solid foods within their prescription range This may be most helpful especially when dealing with small children who due to a cold or other indisposition may refuse to eat the prescribed "solid diet Since insulin dosage is based on food intake it is highly desirable to hold this intake to as constant a level as is possible under all conditions For suggestions see Chapter 28

As reference the following data are offered

Overdosage of insulin results in hypoglycemia or low blood sugar with its chain of symptoms which have been outlined in Table 86

TABLE 86

SYMPTOMS OF INSULIN SHOCK

The early symptoms of insulin overdosage include

[illegible] ible asso-

[illegible]

[illegible] age in pulse rate up to 110 to 1[illegible]0 beats per minute

If these warning signs are disregarded more serious symptoms develop such as

1 Disturbed vision.
2 Dizziness
3 Aphasia and loss of memory
4 Emotional excitement disorientation and delirium
5 Incoordination of the muscles

These will be followed by

1 Marked lowering of the blood pressure
2 Collapse
3 Unconsciousness
4 Death

Insulin shock may occur with great suddenness, and no person suffering from diabetes should ever be without an available source of sugar. If sugar is taken when the first symptoms arise it will frequently avert the shock. The identification card stating that the bearer is diabetic and giving his name, address and the name of the clinic or physician responsible for his care is another wise precaution. It may prevent misinterpretation of his condition.

Hypoglycemia may also result from incorrect distribution of insulin in relation to meals, excessive exercise which reduces blood sugar, or decreased food absorption when a meal is missed or when vomiting or diarrhea occurs.

One might differentiate between these symptoms which occur with regular or crystalline insulin having a time range of four to six hours, those which occur when globulin insulin is used with a range of eight to ten hours, and those of the slower acting protamine zinc insulin with a time range of eighteen to thirty-six hours. The symptoms of inadequate blood sugar following the use of protamine zinc insulin ("P.Z.I.") tend to come in the early morning hours before breakfast and are more insidious. Headache, weakness, depression, confusion, and sometimes nausea are not uncommon, although at times patients awake with the sharper symptoms of tremor, sweating and hunger.

Hyperglycemia, conversely, is high blood sugar and indicates incomplete carbohydrate combustion with potential ketosis and coma. It results from inadequate dosage of insulin, overindulgence in food, infection which lowers sugar tolerance, or erroneous omission of insulin in any case of illness where diet is restricted unnder the mistaken idea that only when the full diet is being ingested should the full amount of insulin be taken. It should be well understood that when food is not eaten, body tissues replace the food source of energy, and at least one half of the usual amount of insulin will be needed.

Simple ketosis is evidenced merely by the presence of acetone bodies in the urine and it is readily overcome by proper dietetic supervision.

The early symptoms of a dangerous **ketosis** are usually of a positive nature consisting of nausea, colic, and abdominal pain.

and especially sudden lack of appetite in a person who previously had a large one. Breathlessness and air hunger are more serious symptoms. Drowsiness is very common.

The unconsciousness of diabetic coma must be differentiated from the unconsciousness of insulin shock, since the treatment of the two conditions is exactly opposite and delay in treatment of either may result in a fatality. Insulin shock comes quickly; coma develops over several hours.

Although the diagnosis of these two conditions can be made from laboratory data, the history and physical examination will give presumptive evidence while waiting for laboratory reports, or, even more important, if they cannot be obtained.

TABLE 87

DIFFERENTIAL DIAGNOSIS OF DIABETIC COMA AND INSULIN SHOCK

DIABETIC COMA	INSULIN SHOCK
Cause	
Increase of diet Omission of insulin Infection	Reduction of diet Increase of insulin Increase of exercise Failure of absorption of food
History	
Gradual loss of consciousness preceded by vomiting No convulsions	Rapid loss of consciousness sometimes followed by vomiting Convulsions
Physical Examination	
Skin dry and flushed Breathing hyperpneic Pulse feeble	Skin moist and pale Breathing shallow Pulse full and pounding
Laboratory Examination	
Blood pressure low Blood sugar high CO_2 under 20 volumes per cent Diacetic acid Urine sugar	Blood pressure normal or high Blood sugar low CO_2 normal or elevated No diacetic acid Urine negative or the second specimen negative

TABLE 88

QUALITATIVE ESTIMATION FOR SUGAR IN THE URINE

Place 5 c.c. (1 teaspoonful) of Benedict's solution in a test tube and add exactly 8 drops of the urine to be tested. Shake gently and heat over a free flame allowing it to boil one minute. The tube may be heated in vigorously boiling water for five minutes with the same results. Allow the tube to cool spontaneously. The color reactions shown in Fig. 67 indicate the amount of sugar present.

TABLE 89

GERHARDT'S TEST FOR DIACETIC ACID (ACETOACETIC)

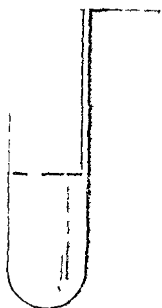
To about 5 c c fresh urine in a test tube add carefully, drop by drop, a 10% ferric chloride solution until no more precipitate forms A red (Burgundy urine) color indicates the presence of diacetic acid Diacetic acid is unstable on boiling Divide specimen into two tubes, boil one and compare to the unboiled sample If color was due to diacetic acid the color will disappear If the color was due to a drug, color will remain though change may take place This is the test commonly used inasmuch as diacetic acid is the easiest one of the ketone bodies to detect

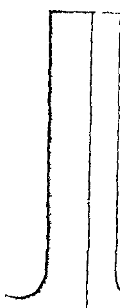
Repeated urine tests for sugar are of value in differentiating Laboratory tests are of extreme value in determining the treatment of the diabetic person With hospitalization, the carbon dioxide level of the blood may be followed as a measure of ketosis change This is of value during recovery from coma if alkali treatment has not been given The carbon dioxide level is a differential between coma and shock Routine tests for the ambulatory and the bed patient consist in measurement of the blood and urinary sugar levels, and of urinary ketone bodies In the home the daily routine is the determination and recording of urinary sugar by the Benedict test, and at times testing for the presence of diacetic acid, one of the ketone bodies Diacetic acid (or acetoacetic acid), beta hydroxybutyric acid, and acetone comprise the "ketone bodies"

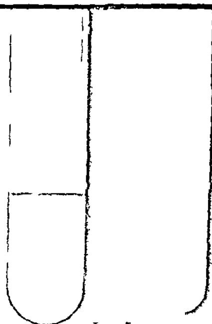
Color change also expresses the extent to which ketone bodies are excreted in the urine The appearance of these bodies is a danger signal a warning of impending coma

Review Questions

1 To which of the three diabetic conditions is the term "diabetes" commonly applied?
2 How is the metabolism of carbohydrate disturbed in diabetes? Of fat? Of protein?
3 What are the classic symptoms of diabetes mellitus?
4 What calculation must be made to determine the total glucose or fatty acid available to the body from ingested food?
5 Why is the fatty acid to glucose (FA G) ratio important?
6 What is the normal amount of glucose in fasting blood? The level found in the diabetic person? The level at which sugar appears in the urine?
7 What types of insulin are available? How do they differ in their effect upon the oxidation of glucose?


Fig 1
Before Boiling


Fig 2
Negative


Fig 5
1 Per Cent Sugar (+++)

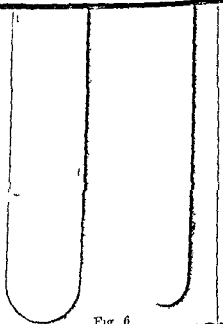

Fig 6
2 to 10 Per Cent Sugar
or possibly more

Fig 67 —The qualitative Benedict test (

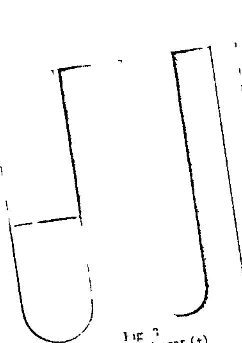


Fig. 3
0.1 Per Cent Sugar (+)

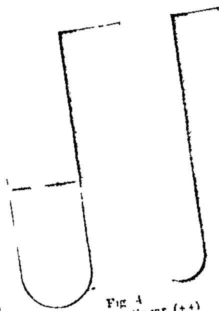
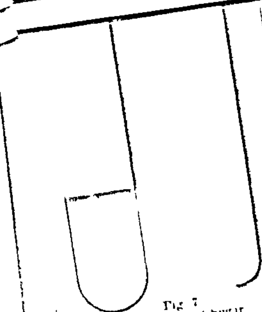
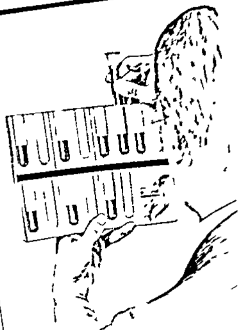


Fig. 4
0.5 Per Cent Sugar (++)



++)

Fig. 7
Over 10 Per Cent Sugar



Courtesy Dr. F. B. Peck, Eli Lilly and Co.

CHAPTER 31

SPONTANEOUS HYPOGLYCEMIA

Spontaneous hypoglycemia, in which abnormal carbohydrate metabolism occurs, may be related to many conditions. The dietary management will be governed by the nature of the initial disorder. In some cases a high protein, low carbohydrate diet is recomended, in others a high protein, high carbohydrate regime is indicated. There is no form of dietary management that is successful in all cases of spontaneous hypoglycemia. The diet prescription will be determined by the condition and individual needs of each patient.

Spontaneous hypoglycemia is an indication of disturbed carbohydrate metabolism which may be a result of one of many conditions. It is important to determine the initial condition as the dietary management can vary considerably. Duncan states that "there has been a widespread, and I believe erroneous, tendency to label all cases in which hypoglycemia occurs as being due to hyperinsulinism." Hyperinsulinism is only one of the many conditions which may bring about hypoglycemia in the patient.

In order to give some concept as to the number of disorders that are capable of bringing about the symptom of spontaneous hypoglycemia, the following classification described by Conn* has been included in Table 90.

There is no one dietary management which is successful in all cases of spontaneous hypoglycemia. A diet modified in one form may prove helpful in some instances whereas it might be contraindicated in another. Conn has found it helpful to classify the different causes of hypoglycemia under two main headings and, on the basis of his experience which has been confirmed by the work of others, has offered two distinct dietary regimens for spontaneous hypoglycemia, depending upon the diagnosis. These two classifications are called "stimulative" and fasting hypoglycemia.

It will be remembered that the elevation of blood sugar that arises from the ingestion of food normally is followed by an

*Conn, J. W.: The Dietary Management of Spontaneous Hypoglycemia. J. Am. Dietet. A. 23: 108-111, 1947.

TABLE 90

ETIOLOGICAL CLASSIFICATION OF SPONTANEOUS HYPOGLYCEMIA

I Organic—recognizable anatomical lesion
- A Hyperinsulinism
  - 1 Pancreatic island cell adenoma
    - (a) Single
    - (b) Multiple
    - (c) Aberrant
  - 2 Pancreatic island cell carcinoma
    - (a) Localized
    - (b) With *metastases*
  - 3 Generalized hypertrophy and hyperplasia of the islets of Langerhans
- B Hepatic disease
  - 1 Ascending infectious cholangitis
  - 2 Toxic hepatitis
  - 3 *Diffuse carcinomatosis*
  - 4 Fatty degeneration, "fatty metamorphosis"
  - 5 Glycogenosis (von Gierke's disease)
- C Pituitary hypofunction (anterior lobe)
  - 1 Destructive lesions (chromophobe tumors, cysts, etc)
  - 2 Atrophy and degeneration (Simmonds' disease)
  - 3 Thyroid hypofunction (secondary to pituitary *hypofunction*)
- D Adrenal hypofunction (cortex)
  - 1 Idiopathic cortical atrophy
  - 2 Destructive infectious granulomas
  - 3 Destructive neoplasms
- E Central nervous system lesions (hypothalamus or brain stem, interference with nervous control of blood sugar)

II Functional—no recognized anatomical lesion, but explainable on basis of unusual somatic function
- A Hyperinsulinism (imbalance of the autonomic nervous system)
  - 1 "Hypoglycemic fatigue"
  - 2 "Nervous hypoglycemia"
  - 3 "Functional hypoglycemia"
  - 4 "Reactive hypoglycemia," etc
- B Alimentary hyperinsulinism (rapid intestinal absorption)
  - 1 Postgastroenterostomy
  - 2 Postgastric resection (partial or total)
- C Renal glycosuria (severe degrees of low renal threshold for dextrose)
- D Lactation
- E Severe continuous muscular work

III Miscellaneous
- A Factitious or surreptitious insulin administration
- B Postoperative hypoglycemia
- C Severe inanition
- D Unknown

CHAPTER 31

SPONTANEOUS HYPOGLYCEMIA

Spontaneous hypoglycemia in which abnormal carbohydrate metabolism occurs may be related to many conditions The dietary management will be governed by the nature of the initial disorder In some cases a high protein low carbohydrate diet is recomended in others a high protein high carbohydrate regime is indicated There is no form of dietary management that is successful in all cases of spontaneous hypoglycemia The diet prescription will be determined by the condition and individual needs of each patient

Spontaneous hypoglycemia is an indication of disturbed carbohydrate metabolism which may be a result of one of many conditions It is important to determine the initial condition as the dietary management can vary considerably Duncan states that "there has been a widespread and I believe erroneous tendency to label all cases in which hypoglycemia occurs as being due to hyperinsulinism " Hyperinsulinism is only one of the many conditions which may bring about hypoglycemia in the patient

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      (a) Localized
      (b) With metastases
    3 Generalized hypertrophy and hyperplasia of the islets of Langerhans
  B Hepatic disease
    1 Ascending infectious cholangitis
    2 Toxic hepatitis
    3 Diffuse carcinomatosis
    4 Fatty degeneration, "fatty metamorphosis"
    5 Glycogenosis (von Gierke's disease)
  C Pituitary hypofunction (anterior lobe)
    1 Destructive lesions (chromophobe tumors, cysts, etc)
    2 Atrophy and degeneration (Simmonds' disease)
    3 Thyroid hypofunction (secondary to pituitary hypofunction)
  D Adrenal hypofunction (cortex)
    1 *Idiopathic cortical atrophy*
    2 Destructive infectious granulomas
    3 Destructive neoplasms
  E Central nervous system lesions (hypothalamus or brain stem, interference with nervous control of blood sugar)
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    1 "Hypoglycemic fatigue"
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    3 "Functional hypoglycemia"
    4 "Reactive hypoglycemia," etc
  B Alimentary hyperinsulinism (rapid intestinal absorption)
    1 Postgastroenterostomy
    2 Postgastric resection (partial or total)
  C Renal glycosuria (severe degrees of low renal threshold for dextrose)
  D Lactation
  E Severe continuous muscular work
III Miscellaneous
  A Factitious or surreptitious insulin administration
  B Postoperative hypoglycemia
  C Severe inanition
  D Unknown

increased insulin secretion, which, in turn, brings the blood sugar back within the normal range The normal individual frequently shows a blood sugar level that is lower than fasting blood sugar *about 1½ to 3 hours after taking carbohydrate* Thus, the absorption of glucose automatically stimulates a mechanism which removes this glucose from the blood

An abnormality which Conn has classified as a **stimulative hypoglycemia** may occur when this mechanism is excessively sensitive to the normal stimulus or when it is excessively stimulated by an abnormally high absorption of glucose When either of these reactions takes place a sharp fall of the blood sugar level occurs, which is secondary to the stimulus Clearly, a high carbohydrate diet will only aggravate a spontaneous hypoglycemia of this origin It would probably produce frequent and severe attacks

Functional hyperinsulinism can serve as an excellent example of the first abnormality mentioned above, an excessive sensitivity to absorbed glucose This condition is believed to be the most common cause of hypoglycemia as it is responsible for approximately 70% of all cases In functional hyperinsulinism, the fasting blood sugar is always normal The glucose tolerance test shows a normal elevation of blood sugar *following absorption* but it then drops quickly to the level of hypoglycemia Patients *suffering from this condition do not experience attacks* before breakfast and most occur from two to four hours after meals and usually in the midmorning and midafternoon It is believed that an ingestion of carbohydrate brought about the secondary hypoglycemia

At first, in 1931, a low carbohydrate diet was advocated by Waters But in 1936 Conn recognized the importance of a *high protein, low carbohydrate regimen Carbohydrate is quickly* absorbed directly into the blood stream, while protein after being split into component amino acids, is carried to the liver, deaminized, and then 58% is converted to glucose The release into the blood stream of glucose from protein is a slow and even process It is so slow that a rapid elevation of blood sugar does not occur and the secondary stimulation of the insulin secreting mechanism does not take place

Conn suggested a diet composed of 120 to 140 gm of protein, from 50 to 75 gm of carbohydrate (initially 50 gm), and the

TABLE 91

ILLUSTRATIVE DIET FOR THE TREATMENT OF STIMULATIVE HYPOGLYCEMIA

Protein	130 gm	Carbohydrate	75 gm
Fat	154 gm	Calories	2,300

EXCHANGES	AMOUNT	PRO GM	FAT GM	CHO GM
Milk	2 cups	16	20	24
Vegetable—Group A	As desired	--	--	--
Vegetable—Group B	None	--	--	--
Fruit	2 exchanges	--	--	20
Bread	2 exchanges	6	--	30
Meat	15 exchanges	105	75	--
Fat	12 exchanges	--	60	--
		127	155	74

Suggested Menu

(The servings are the portions described in the representative exchange list)

Breakfast

Orange juice	4 ounces
Eggs, scrambled	2
Bacon, sliced, cooked	2
Toast	1 slice
Butter	1 teaspoon
Coffee	As desired
Cream	2 Tablespoons

Dinner

Clear broth	
Roast beef	7 ounces
Asparagus	As desired
Butter	1 teaspoon
Lettuce and tomato salad	As desired
Mayonnaise	1 teaspoon
Lemon gelatin*	As desired
Whipped cream	2 Tablespoons
Roll	1
Butter	1 teaspoon
Coffee	As desired
Cream	1 teaspoon
Milk	8 ounces

Supper

Roast chicken	6 ounces
Broccoli	As desired
Butter	1 teaspoon
Chef's salad	As desired
French dressing	1 teaspoon
Half grapefruit	1 medium
Coffee	As desired
Cream	1 teaspoon
Milk	8 ounces

*Unflavored gelatin and lemon juice

remainder of the necessary calories provided from fats The carbohydrate should be divided equally among a three meal program Using the exchange method described in Chapter 30, an illustrative menu plan has been calculated which will meet the nutritional needs of the 25 year old "reference" woman of the the Recommended Allowances of the National Research Council (see Chapter 2) The calculations for this menu plan and a suggested menu will be found in Table 91

The second type of stimulative hypoglycemia can occur when the insulin regulating mechanism is excessively stimulated by an abnormally high absorption of glucose This condition is called **alimentary functional hypoglycemia** by Conn Whenever the pyloric sphincter is removed from the gastrointestinal tract through surgical procedures, there is rapid delivery of food upon the highly absorptive mucosal lining of the small intestine This in turn is likely to produce periodic spontaneous hypoglycemia as an excessive stimulus has taken place The high protein, low carbohydrate diet regimen previously described has been effective in the treatment of this form of spontaneous hypoglycemia

The **fasting hypoglycemia**, the second classification listed by Conn, has an abnormally low fasting blood sugar level The hypoglycemia becomes more severe when there is a restriction of carbohydrate or when the patient fasts Those conditions which may bring about fasting hypoglycemia are hepatogenic hypoglycemia, hypopituitarism, adrenal cortical hypoglycemia, and prolonged inanition This classification of hypoglycemia occurs when there is not enough carbohydrate available to support tissue oxidation over any period of time This may occur overnight or when a meal is omitted The leading causes of fasting glycemia are a disturbance of the normal function of the body's ability to form glucose from amino acids and fatty acids

The dietary treatment in this type of hypoglycemia recommended by Conn is high protein high carbohydrate, and the remainder of the calories in fat It may be necessary to include a bedtime feeding in this regimen

There is a third condition known as **organic hyperinsulinism**, which is both a stimulative and fasting hypoglycemia according to Conn This condition is also known as pancreatic insuloma

(tumor of the islets of Langerhans) Neither of the diets previously described proves satisfactory Surgical intervention has alleviated the hypoglycemia

Thus the dietary management of spontaneous hypoglycemia depends upon the diagnosis as to its cause Once this has been ascertained the diets described in the preceding paragraphs may be applicable for a specific patient or another distribution of carbohydrate fat and protein may seem advisable Those suggested are possible prescriptions In planning the menus a great variety is possible within the framework of each exchange list There are many interesting combinations such as custard desserts casserole main dishes and cheese in many forms which are allowed In addition it must be remembered that those foods having little or no calories listed in Table 84 in Chapter 30 may also be included in the diet Recently Abrahamson* has offered a thought provoking suggestion namely that hyperinsulinism with the subsequent hypoglycemia may result in nerve damage due to glucose starvation and may be a precursor of multiple sclerosis He suggests the use of the Seale Harris Diet and intramuscular calcium

Review Questions

1 What is spontaneous hypoglycemia?
2 What are some of the conditions that may bring about spontaneous hypoglycemia?
3 What are the two classifications of hypoglycemia listed by Conn?
4 What are the conditions that are represented in each classification?
5 What is the blood sugar picture in each classification? How do the symptoms differ?
6 What are the diets suggested in the management of each classification? How do they fit into the metabolic picture?
7 How does the blood sugar curve in each classification of hypoglycemia differ from that of the normal individual?

Suggested Project

1 Taking the same diet prescription as suggested in this chapter for stimulative hypoglycemia calculate a possible diet pattern for a 25 year old woman Or do the same for a 1 year old boy

*Abrahamson L M New York J Med 54 June 1 1954

CHAPTER 32

THE KETOGENIC DIET

The ketogenic diet, which is used primarily in treating epilepsy, consists of a calculated high fat, low carbohydrate regime The degree of relief derived from this form of treatment is controversial The diet is difficult to administer and is nutritionally inadequate It is necessary that the patient remain on the ketogenic diet for at least several months to obtain maximum benefit

The ketogenic diet is based on the theory that when the ratio of ingested fatty acid to glucose exceeds 2, ketone bodies circulate in the blood and produce a mild ketosis or acidosis (see discussion of the ketogenic antiketogenic ratio), a sedation which exerts a beneficial effect in several clinical conditions The first use of this type of diet was for the control of epilepsy

Epilepsy, a condition rather than a true disease, has been described for many centuries Ancient writers attributed it to evil spirits and various attempts were made to drive them out Although various theories have been advanced to explain the nervous mechanism involved in the precipitation of the attack or seizure, none is satisfactory Some have observed that there might be heritable tendencies in epilepsy The suggestion that it is due to some sudden change probably metabolic in origin in the physiochemical relationship within the brain has led to the attempt to control the attacks by dietary adjustment However no single specific change has ever been found at autopsy to be specifically associated with epilepsy

In 1921 Geyelin called attention to the beneficial result which fasting exerted on epilepsy and recognized the part which acidosis plays In the same year Wilder suggested the use of the ketogenic diet as a more practical and equally satisfactory method of treatment Since then a measure of success has been obtained by the use of these diets especially in children

Lennox and Cobb in 1928 stated that in certain epileptic persons who were subject to frequent seizures the attacks could be precipitated by lack of oxygen or by alkalosis and conversely these attacks could be prevented by increased oxygen intake and

by ketosis Obviously, it is not practical to maintain patients in a condition of controlled oxygen or carbon dioxide tension, but it is possible to control their state of ketogenic antigenic balance

McQuarrie later (in 1929) expressed the belief that the epileptic tended to retain water and that diuresis tended to postpone seizures and suggested that water restriction was of added value

Today, there are approximately 800 000 people in this country who suffer from epilepsy Through the increasing use of drugs and the aid in treatment from the electroencephalograph, control of epilepsy is progressing The ketogenic diet does not play as great a part as it once did in the treatment of this disorder It is difficult to ingest it is unpalatable it poses problems for the patient who must eat some of his meals out, and it is nutritionally unbalanced Because of these objections it is infrequently recommended However, some clinicians report a measure of success in the treatment of epilepsy in children by use of the ketogenic diet

In administering the diet it is preferable to increase the fat slowly rather than to place the patient on the drastically different diet immediately In some instances however, an initial fast period has proved of value The gradual increase in fat and the decrease in carbohydrate make possible eventually an FA G ratio of as high as 3 1 or 4 1 with a minimum of discomfort

To calculate the ketogenic diet is simple to fulfill the prescription is less easy Since the ketogenic diet must be maintained over long periods in some cases for life the ketogenicity and low water intake must be the only factors of imbalance The diet may be planned in a manner similar to that for the diet of the diabetic patient (See Table 77)

McQuarrie suggests that the total water intake be calculated as

30 40 gm per kilogram for the preschool child
20 30 gm per kilogram for the child from 5 to 10 years
15 25 gm per kilogram for the child 10 years and over

If the sodium chloride is held at the minimum level for safety of 2 to 3 gm daily, the possibility of water retention will be decreased

Absolute adherence to the diet, except under certain conditions of drug therapy, is imperative if any degree of success is to be achieved. Minor adjustments may have to be made in order to adapt the diet to the individual, but these should be few. Discouragement must not be felt if no improvement is noticed within the first six months of dietary restriction. Long periods are sometimes necessary to bring about a noticeable effect. When the patient has been free from attack for several months under such a regime, there may be some relaxation in the ketogenicity of the ratio.

Lower protein levels are sometimes suggested than are here indicated and McQuarrie calls attention to the dangers of this practice on the basis of two facts: first that ketosis enormously steps up the patient's protein requirement, and also that protein starvation tends to increase water storage, and thus defeats the attempt at dehydration. McQuarrie suggests that protein levels up to 2 gm. and over are more nearly adequate than that of 1 gm. and under.

TABLE 92

KETOGENIC ANTIKETOGENIC FOODS

KETOGENIC	ANTIKETOGENIC
Meats	Sugars
Fats	Starches
Some fish	Cereals
Egg yolk	Milk
Cheese	Fruits
Nuts	Vegetables

Again, using the 25 year old reference woman (see Chapter 2) as an example, a diet containing 2,300 might be divided into a ketogenic ratio by approximately the following prescription: Protein 63 gm., Fat 219 gm., and Carbohydrate 31 gm. Table 77 shows the possible calculations, by the exchange method, for such a prescription, and also it includes a day's possible menu. It has been found that many patients would prefer ingesting a high fat drink (somewhat like a glass of medicine) to having all foods covered with rich sauces. Thus, in Table 93 a drink which may be given in two "doses," midafternoon and evening, is included. It is also advisable to include at least one "simple" food, that is one food that is not high in fat, at each meal.

TABLE 93

ILLUSTRATIVE KETOGENIC DIET

Protein 63 gm Carbohydrate 31 gm
Fat 219 gm Calories 2,300

FOOD	AMOUNT	PRO GM	FAT GM	CHO GM
Milk, whole	½ cup	4	5	6
Vegetable—Group A	4 exchanges	--	--	-
Vegetable—Group B	None		--	--
Fruit	1 exchange	--	--	10
Bread	1 exchange	3		15
Meat exchanges	8 exchanges	56	40	--
Fat	35 exchanges	-	175	-
		63	220	31

Suggested Menu

Breakfast	
Orange juice	4 ounces
Egg scrambled	1
Butter	2 teaspoons
Bacon	3 slices
Toast	1 slice
Butter	1 teaspoon
Coffee	As desired
40% cream	2 Tablespoons
Noon	
Roast beef	3 ounces
Asparagus	1 serving
Butter	2 teaspoons
Lettuce wedge	
Mayonnaise	2 teaspoons
Lemon gelatin*	
Whipped cream	2 Tablespoons
Coffee	As desired
40% cream	2 Tablespoons
Midafternoon	
½ special high fat "drink"†	
Dinner	
Roast chicken	3 ounces
Broccoli	1 serving
Butter	1 teaspoon
Tossed green salad	1 serving
French dressing	2 teaspoons
Bavarian cream‡	One portion
Coffee	As desired
40% cream	2 Tablespoons
Evening	
1 special high fat "drink"†	

* *Lemon Gelatin*
Plain unflavored gelatin
Lemon juice
Saccharine

† *High fat drink*
½ cup milk
1 cup 40% cream
1 egg
¼ teaspoon vanilla
Nutmeg

‡ *Bavarian Cream*
Plain unflavored gelatin
40% cream
Saccharine
Vanilla

The curtailment of carbohydrate in the form of cereals and cereal products and the curtailment of milk because of its water and sugar content bring about a deficiency of the B vitamins in the diet, and a commercial source of this complex must be used Because of the curtailment of milk, the diet is also deficient in calcium This is a matter of importance in child patients and their diets must include calcium supplementation Cheese can partially replace milk, or for young children a milk substitute may be prepared by mixing 40% cream with 4% calcium caseinate in water, which has been sweetened to taste with saccharine

Fruits and vegetables served as salads prevent loss of vitamins and minerals and also act as vehicles for large quantities of cream or mayonnaise dressings

Egg yolk is preferable to the whole egg and may be used as garnish, made into noodles by slowly adding it to rapidly boiling liquid and beating with a fork to break into shreds or it may be scrambled with butter or cream

Forty per cent cream should be used because it has a lower water and higher fat content than lighter cream

Ice cream, custard, puddings made from cream, egg yolk, saccharine, and flavorings all may be eaten Diabetic or unflavored gelatins may be prepared using cream as the liquid In most cases foods which contain a negligible amount of carbohydrate, such as those listed in Table 84, may be included in the diet

Gluten products, breads cereals muffins cookies etc, are justifiable on this type of diet They are starch free and since the *fatty acid and glucose are approximately equal* they can become ketogenic by acting as carriers of butter In addition they make possible the inclusion of bread and cereal in the diet

The ketogenic diet is also used in the treatment of migraine and for infections of the urinary tract

Review Questions

1 What theory is the basis for the ketogenic diet?
2 For what conditions might this diet be used?
3 In addition to the ketogenic diet what other means are used to prevent seizures in the epileptic?
4. What adjustments from the normal are made in the food nutrients in the ketogenic diet prescription?

5 What range of percentage of the total calories may be given as protein? What range for fat? Carbohydrate?
6 What ratio of FA G may safely be used?
7 What are the indications in regard to water and salt in conjunction with the diet?
8 What foods are used in filling a ketogenic prescription?
9 What are the objections to the ketogenic diet? How may some or all of them be remedied?

Suggested Projects

1 Calculate a ketogenic prescription for a 10 year old girl according to the pattern set forth in Table 77 Calculate a food pattern, using the exchange method, and then plan a day's menu from the caculated food pattern Evaluate the nutritional value of the menu In what nutrients is it lacking (use the recommended allowances of the National Research Council as a standard in Table 3)? Can you modify the pattern to remedy any or all of these deficiencies (if they exist)? What percentage of the day's need must be supplemented from vitamin concentrates?
2 Answer the same questions listed in No 1, using a 65 year old woman who must eat all of her meals away from home as your possible patient What special difficulties might she have that another patient might not encounter, difficulties in following a ketogenic diet?

amounts of fruits and vegetables should be used, and a fish oil preparation should be supplied as a source of vitamin D

Such a diet takes cognizance of the recent theories underlying the dietary treatment of arthritis and combines them into a well balanced diet Adjustment in bulk content can easily be made whenever necessary The diet may be liquid, soft, smooth, or high in roughage In making adjustments, care should be taken to maintain adequacy The vitamin B complex, especially vitamin B_1, and vitamin C should be added if they are not supplied in sufficient amount in the foods chosen

So far as rheumatoid arthritis itself is concerned, the diet should be a balanced normal diet, rich in vitamins, minerals, and protein, low in calories to maintain body weight However, since their discovery, ACTH and cortisone have been used in the treatment of many cases of rheumatoid arthritis Because of the influence of these hormonal medications upon the electrolyte balance of the body, it is usually necessary to place the patient upon a low sodium diet When this occurs, the diet principles described for arthritis are combined with those outlined in the low sodium regimen (see Chapter 39) Of course, the extent to which both the sodium and the calories are restricted is based upon the individual needs of each patient

Degenerative arthritis is a condition which accompanies advancing years According to general opinion it has little cause other than that due to the wear and tear of "long continued trauma" It is usually insidious in its onset and appears with equal frequency in both sexes after 40 years of age From a dietary standpoint it is usually suggested that if the patient is overweight, he reduce Other than that, a normal diet, similar to the one indicated for rheumatoid arthritis, is usually prescribed

Gout is a metabolic disturbance in which uric acid is excreted with difficulty by the kidneys, the acid is raised to a high level in the blood, and, as a consequence, the sodium salt of the acid (sodium urate) is deposited in various parts of the body This abnormality Hench suggests is probably a result of, rather than the cause of gout Gout occurs predominantly in men is usually associated with overweight has its onset around or after middle life, and is markedly hereditary in occurrence The attack, which appears as an inflammatory process, is characterized

by swelling local heat redness and pain in one or more joints The great toe especially is involved Eventually permanent changes result from gouty deposits

Uric acid is a normal constituent of blood arising from two sources—exogenous or from food and endogenous or from the body's own tissues It arises from the breakdown of nucleo proteins (see Chapter 5 Proteins) of plant and animal cells Nucleoprotein as a result of the metabolic process is broken down into purines which in their turn are oxidized to uric acid Under ordinary conditions the body readily excretes the excess uric acid in the urine but in gout for some obscure reason ex cretion is impaired The endogenous uric acid cannot be altered since breakdown of body tissues goes on throughout life the exogenous fraction can be controlled by diet It has been found recently that uric acid may be synthesized within the body from *simple carbon and nitrogen compounds Although a high uric* acid concentration in the blood accompanies the deposition of sodium urate in gout there is no evidence that hyperuricemia is the sole cause of this urate deposition

Although the cause for gout is unknown many foods have often been accused as being the precipitating factor It has been suggested that eating foods rich in purines foods rich in pro tein habitual dietary excesses and periodic indulgence in al coholic beverage will bring about an attack of gout Bauer and Klemperer writing in Duncan's *Diseases of Metabolism* point out that these suggested relationships between the intake of certain foods and the consequent gout have not been sufficiently estab lished by scientific research

In the past the diet used in gout was traditionally low in fat essentially free or low in purines and only moderately high in total protein However because of the newer beliefs concerning purine metabolism there is no general agreement in the dietary regimen Some clinicians rigidly restrict the purine content of the diet others restrict those foods especially high in purine content Both suggestions will be included in the following dis cussion

Glandular organs liver kidney sweetbreads (thymus and
creas) are especially rich in nucleoproteins Muscle
relatively rich as is the germ of grains and the act
part of plants such as the tips of asparagus the

or beans, etc Most vegetables are essentially purine free, fruits and the milled grains or cereals are entirely so Inasmuch as the germ is attached to whole grain cereals, in this form, they are precursors of purines Milk is purine free, as are also hen's eggs Table 94 gives details concerning the purine content of most

TABLE 94

PURINE CONTENT OF VARIOUS FOODS (J SCHMID AND G BESSAU)*

100 GM	BASES N IN GRAMS	URIC ACID IN GRAMS
Meat		
Beef	0.037	0.111
Veal	*0.038*	*0.114*
Mutton	0.026	0.078
Pork	0.041	0.123
Boiled ham	0.025	0.075
Smoked ham	0.024	0.072
Smoked salmon	0.017	0.051
Smoked tongue	0.055	0.165
Liverwurst	*0.038*	*0.114*
Blutwurst	0	0
Brains	0.028	0.084
Liver	0.093	0.279
Kidney	0.080	0.240
Sweetbreads	*0.330*	*0.990*
Lungs	0.052	0.156
Chicken	0.029	0.087
Squab	0.058	0.174
Goose	0.033	0.099
Venison	0.039	0.117
Pheasant	0.034	0.102
Bouillon (*100 gm* beef)	*0.015*	*0.045*
Fish		
Shell fish	0.039	0.117
Codfish	0.038	0.114
Eel (smoked)	0.027	0.081
Salmon (fresh)	0.024	0.072
Carp	*0.054*	*0.162*
Pike	0.045	0.135
Pike	0.048	0.144
Red herring	0.028	0.084
Herring	0.069	0.207
Trout	0.056	0.168
Sprot	0.082	0.246
Sardines	*0.118*	*0.354*
Sardel	0.078	0.234
Anchovies	0.145	0.465
Crabs	0.020	0.060
Oysters	0.029	0.087
Lobster	*0.022*	*0.066*
Eggs		
Hen's eggs	0	0
Caviar	0	0
Shad roe	0	0
Milk and Cheese		
Milk	0	0
Edam cheese	*0*	*0*
Swiss cheese	0	0
Limburger cheese	0	0
Tilsit cheese	0	0
Roquefort cheese	*0*	*0*
Cream cheese	0.005	0.015
Dairy cheese	0.022	0.066
Vegetables		
Cucumber	0	0
Lettuce	0.003	0.009
Radish	0.005	0.015
Cauliflower	0.008	0.024
Garlic	*Traces*	*Traces*
Spinach	0.024	0.072
Carrot	0	0
Green cabbage	0.002	0.006
Red cabbage	0.002	0.006
Rape cale	*0.011*	*0.033*
Celery	0.005	0.015
Asparagus	0.008	0.024
Onions	0	0
String beans	0.002	0.006
White potatoes	0.002	0.006
Shell beans	0.027	0.081
Peas	*0.018*	*0.054*
Lentils	0.054	0.162
Beans	0.017	0.051
Mushrooms	0.018	0.054
Fruit		
Bananas	0	0
Pineapple	*0*	*0*
Peaches	0	0
Grapes	0	0
Tomatoes	0	0
Pears	*0*	*0*
Plums	0	0
Whortleberries	0	0
Oranges	0	0
Apricots	0	0
Blueberries	*0*	*0*
Apples	0	0
Alomus	0	0
Hazelnuts	0	0
Walnuts		
Cereals		
Grits	0	*0*
Barley	0	0
Rice	0	0
Tapioca	0	0
Sago	0	0
Oatmeal	0	*0*
Millet	0	0
Rolls	0	0
Light bread	*0*	0

*From *Therapeusis of Internal Diseases* by Forchheimer D Appleton Century Co

foods Table 95 indicates a dietary regimen which might be followed when a low purine diet is indicated

From the tabulation it is evident that meats, fish, and poultry must be strictly limited, while glandular meats must be eliminated entirely Protein must be derived almost entirely from milk and egg For palatability, a small serving of muscle meat

TABLE 95

ILLUSTRATIVE LOW PURINE DIET

Include these foods each day				
Milk—1 pint				
Meats, poultry, or fish—2 oz of all (Group II) except those excluded (Group I)				
Eggs—at least one or more				
Bread, cereal, cereal products—as desired				
Potato—as desired (except fried)				
Vegetable, green leafy—all except limited amounts of those listed in Group II				
Vegetable, other—all except limited amounts of those listed in Group II				
Fruit, citrus—at least one serving				
Fruit, other—at least one serving				
Fat—butter fortified margarine, oils cream—as desired				
Miscellaneous—coffee cocoa				
Group I—Foods omit (high purine content)				
Liver	Kidney	Anchovies	Mussels	Alcohol
Sweetbreads	Sardines	Squab	Scallops	
Meat extracts	Gravy	Goose	Yeast baker's and brewer's	
Group II—Limited amounts moderate purine content)				
Beef	Game	Beans		
Veal	Fowl	Peas		
Mutton	Fish	Lentils		
Lamb	Shellfish	Spinach		
Pork	Fish pastes	Mushrooms		
Pork products				
Group III—Eat freely (negligible purine content)				
Milk	Mayonnaise	Breads	Sugar	Tea
Cheese	Vegetable oils	Cereals	Nuts	Coffee
Butter	Fruits (all)	Cakes cookies etc	Gelatin	Cocoa
Eggs	Vegetables (except above)	Sweets	Ice cream	

is permitted once or twice a week possibly leading up to daily use, depending upon how drastically the diet must be curtailed Finely milled cereals and fruits are consumed as desired, as are vegetables, with the exceptions previously noted The normal diet contains from 600 to 1,000 mg of purines daily, a low purine diet contains from 100 to 150 mg

Further restrictions are thought to be of clinical value, namely, a total caloric intake decreased somewhat below the normal value for the individual when in health A slight state of undernu-

trition is much to be preferred to obesity A weight below normal by 10 to 15% is satisfactory High caloric intake, regardless of type of food ingested, predisposes to attacks, which is an added reason for caloric restriction.

The total protein level for the patient with gout is planned not to exceed 1 to 1¼ gm per kilogram of body weight High protein, even though it is purine free, tends to raise the uric acid level of the blood Restriction of fat is thought by some to be of value in decreasing the severity and the frequency of the attacks It has been suggested that fats inhibit purine excretion Levine pointed out that it has been observed that a high fat intake seems to predispose to acute attacks of gouty arthritis

Coffee and tea contain caffeine, which, in turn contain purine bodies that some believe may be converted into uric acid Those who advocate a low purine diet usually restrict the coffee and tea intake to one cup per day Those who follow a more liberal regimen, such as that suggested by Levine and Bauer and Klemperer (references cited in Appendix), do not limit these beverages

Alcohol is believed to aggravate the disturbance and is usually sharply curtailed Rich highly seasoned foods should be avoided, as should gravies, meat broth and meat stock soups Sodium chloride should be used sparingly and water should be taken in abundance Last, but by no means least the diet should be continued in conjunction with strict adherence to general rules of health

TABLE 96

FOODS OMITTED ON A MODERATELY RESTRICTED DIET IN THE TREATMENT OF GOUT

FOOD	PURINE CONTENT MG /100 GM
Sweetbreads	825
Anchovies	360
Sardines	300
Liver	230
Kidneys	200
Brains	195
Meat extracts	150

Bauer and Klemperer question the need of drastic dietary restrictions They contend that nowhere have they found sufficiently well controlled dietary studies involving uric acid levels, dietary changes, and the clinical course of the disease Their treatment is

avoidance of overweight and a diet which contains adequate amounts of protein, iron and vitamins They feel that drastic curtailment of purine intake results in a "monotonous and unpalatable diet," as well as one conducive to the development of deficiencies They restrict only excessive purine intake through the foods listed in Table 96

Since the values given for the purine value of foods in their opinion are controversial and since the amounts, other than those previously indicated are small they can be neglected in the diet planning They even permit small amounts of alcohol The preferable type of treatment therefore, is still open to question

During an attack of gout which is usually of short duration the diet adjustment may need to be drastic At this time a purine free diet is often followed This consists of a moderate amount of skim milk an abundance of fruit and fruit juices cereal with milk crackers and large quantities of water When the attack is over either the diet outlined in the general discussion as low purine or the one recommending moderate purine restriction should again be followed

Review Questions

1 Differentiate between rheumatoid arthritis and degenerative arthritis
2 What at the present time is considered the best diet for patients with arthritis?
3 Upon what theory is this diet based?
4 What other modifications may be made of the diet in arthritis?
5 What is gout? What are the characteristics of gout?
6 What is the relationship between purine metabolism and the uric acid content of the blood?
7 What adjustments of diet are believed necessary in treating gout?
8 What foods are highest in purines? What foods may be eaten freely?
9 During an acute attack what type of diet is advised?

Suggested Projects

1 Interview a patient with gout Discover if he himself has noticed any relationship between the foods that he eats and the incidence of attacks What is his reaction to the diet prescribed for him? How liberal is the diet in terms of the discussion in the chapter?
- Examine your own weekly menus What modifications would you have to make to have a low purine diet? Are these changes compatible with your food pattern? What problems would you encounter if you followed this diet?

the elimination of potassium is increased. Renal function is restored and the accumulation of nonprotein nitrogen in the blood is reduced However, the administration of desoxycorticosterone does not correct the defect in carbohydrate metabolism and the diet must contain large amounts of readily available carbohydrate. This can be accomplished by three small meals with interval and bedtime feeding. Usually, when the patient is receiving hormonal therapy, sodium chloride is also given Most clinicians have indicated that a diet low in potassium is not necessary at this time. It is necessary to maintain a fine balance between the amount of desoxycorticosterone and sodium chloride administered to the patient. This, of course, is determined in the initial prescription and the sodium content of the diet is adjusted accordingly.

Before hormonal therapy was instituted in 1929 and today, with certain patients, it is necessary to reduce the intake of potassium in the food from the normal 4 gm. daily to about half that amount. This can be accomplished by the omission of certain foods and by the special preparation of others. Cantrow* lists four basic steps whereby this may be arranged.

(1) Limit the selection of bread, cereal, and sugar to highly refined products.
(2) Avoid those soups, broths, and gravies which contain meat stock or meat extracts, catsup, chili sauce, mustard, and other meat sauces and seasonings, dried fruits and vegetables, bran, molasses, Postum, and chocolate.
(3) Restrict moderately the use of milk, meat, fruit, vegetables, and condiments.
(4) Meat and vegetables should be cooked by a special method whereby their potassium content is lowered The latter and meat should be cut into small pieces and cooked in six to eight times their bulk of water in Patapar (parchment paper) bags By this method the potassium content of vegetables may be reduced 60 to 70% and that of meats about 75%

The tables of potassium and sodium chloride content of foods of value in planning the dietary of the patient with Addison's disease are listed in the Appendix, Tables 124 and 124A.

The diet of these patients may follow the schematic outline for the normal diet, with special emphasis on liberal intake of protein and carbohydrate, moderate use of foods of high calcium

*In Duncan Diseases of Metabolism, ed 3 W B Saunders Co, p 303

content, curtailment of potassium, liberal use of foods high in sodium chloride, and generous intake of water The diet must be adequate calorically to correct weight loss or to maintain weight Fat is a logical means of increasing calories if a distaste for fat does not ensue Carbohydrate may be increased by the use of candy, sweetened drinks, and other means

The curtailment of whole grain cereals, the discarding of the cooking water of vegetables, the restriction of certain vegetables and fruits, and the limitation on milk intake result in a dietary low in vitamin B complex Supplementation by commercial vitamin B, and probably also by ascorbic acid (vitamin C) is, therefore, necessary Experimentation is reported that suggests beneficial results from generously increased amounts of vitamin C. The normal adrenal gland contains a high percentage of ascorbic acid

Future developments in therapy for this condition are awaited with keen interest Fortunately, Addison's disease is not common It occurs in the third to fifth decades of life, and most commonly in males

Review Questions

1 Describe the metabolic disturbances that have occurred in Addison's disease
2 What are the early symptoms of this condition? What symptoms follow?
3 What changes in the blood picture occur in this disease?
4 What are the prinicples of the dietary management of this condition?
5 How may the normal diet be modified in Addison's disease?
6 How do these modifications affect the nutritional value of the diet? If adjustments need to be made what might they be and how might they be accomplished?

Suggested Projects

1 Prepare either meat or vegetables in the manner suggested in the preceding paragraphs Note the length of time it takes you to prepare the food Do you care for the flavor of the food? The texture? What problems do you think a patient might encounter if he prepared his foods in this way every day?
2 Using the tables of potassium and sodium chloride content of foods in the Appendix, calculate a day's menu for the 25 year old adult woman that contains 2 gm of potassium Is the menu adequate in other nutrients? If not, which ones are lacking? Can you remedy this by a change in food?

CHAPTER 35

DISORDERS OF THE GASTROINTESTINAL TRACT

Most disorders which affect the gastrointestinal tract are the end results of errors in diet, disturbed motility and tone, or abnormalities in the secretory processes Heredity, poverty, neurological or specific disease conditions may be associated causes Other disturbances are common to the gastrointestinal tract but are not associated with specific disease entities Among these are constipation, diarrhea, and flatulence In the dietary treatment of gastrointestinal disorders, food may be modified in texture, consistency, composition, and type of service In addition, the replacement of nutritional losses, the maintenance of a good nutritional state through individual diets are desirable

Obviously any disturbance that interferes with the normal functioning of the gastrointestinal tract will affect the digestion and absorption of food The reader is referred to Chapter 6 where the mechanics and hygiene of the gastrointestinal tract are discussed in detail However, a brief résumé will be presented here It will be remembered that there are essentially five sections or parts of the gastrointestinal tract the mouth the esophagus, the stomach, the small intestine, and the large intestine The mouth receives food and prepares it mechanically for digestion The breakdown of starches may take place to a small degree The esophagus carries the food from the mouth to the stomach In the latter organ, some protein digestion takes place, the food is stored for a short time, and the food mass undergoes further mechanical treatment until the food is in a liquid form when it passes into the small intestine Here, the splitting of carbohydrates, fats, and proteins are completed, and eventual absorption of nutrients, vitamins, and minerals, as well as those mentioned previously, takes place After the absorption of nutrients, the indigestible fiber and the waste products of digestion pass into the large intestine or colon There, the excess water is reabsorbed, and the fecal mass is formed for eventual evacuation Whenever there is hindrance of any form, such as an abnormality in the rate of gastrointestinal motility, an ob

struction or lesion or a disturbance in the secretory processes of the normal functions the diet of the patient has to be modified to refrain from aggravating the specific complaint Also, the nutritional needs additional demands in some instances as well as the normal requirements should be administered

Disorders in the Mouth

As indicated above in the mouth if the teeth are intact, food is broken into fine particles mechanically and is mixed with saliva Anything which interferes with these functions obstructs the first step in the digestive process and if for any reason the chewing of the food cannot be performed a diet must be adopted that is of such consistency as to obviate the need for chewing Carcinoma mouth injury or inflammatory conditions of the mouth tissues call for liquid diet In ulceration inflammation or obstruction of the esophagus a liquid diet may be used In inflammation of the esophagus the diet must be bland as well as liquid and in acute cases the condition may require gastrostomy (establishment of a gastric fistula) to prevent malnutrition or starvation Cardiospasm (failure of the esophagus stomach sphincter to relax normally in the swallowing reflex) will call for a bland liquid diet which is neither excessively hot nor cold as the excessive temperatures have a tendency to interfere with normal reflex action

Disorders in the Stomach

Abnormalities of the stomach may be roughly divided into two classifications which might be termed *functional* and *conditional* The former functional might refer to disorders related to the actual normal functioning of the stomach such as gastric atony hyperchlorhydria and hypochlorhydria The latter classification conditional may include abnormalities that may be a result of other disturbances which might bring about a singular disorder that affects the normal diet These abnormalities would include acute and chronic gastritis peptic ulcer hemorrhaging ulcer and gastric obstruction

An alteration of tone in which the stomach muscles fail to contract normally and food is retained in the stomach beyond the normal time is frequently called **gastric atony** Smaller and

more frequent feedings, the use of a concentrated liquid diet or a smooth diet low in fat and low in total liquid may be used in this condition This may be the soft diet described in Chapter 27 If it is low in fat it will not delay the normal emptying time of the stomach as a diet higher in fat would tend to do In some cases attention to the B vitamins, especially thiamine, has been indicated Frequently, with improvement in general health there is return to normal tonicity and an adequate diet is important as a means to this end Gastric atony may be associated with a variety of other disorders as well as one phase of generalized muscular weakness In some cases of hypomotility, the food may not leave the stomach and the stagnated contents may ferment and cause distress

Hyperchlorhydria (hyperacidity) will result if hydrochloric acid is present in the gastric juice above the normal level of 0 2 to 0 4% This condition, not a disease entity in itself is frequently secondary to other pathological conditions and predisposes to the distressing gas acid eructations, "heartburn" etc sometimes encountered Nearly all patients with gastric ulcer and many high strung, nervous individuals show this increased stomach acidity The acid is irritating to the tender mucous membranes of the stomach and, if unchecked, results in inflammation of the lining tissue The degree of stomach acidity can be readily determined by gastric analysis Treatment consists in decreasing or neutralizing the acidity A low residue diet is used as pressure tends further to stimulate the acid producing cells Stimulating foods are eliminated, and the diet must be bland but not tasteless—as frequently results by too low a level of seasoning in the zeal to eliminate stimulating ingredients (see Chapter 16, Food Adjuncts) The protein level should be high since in the process of digestion the protein ties up with the gastric hydrochloric acid and reduces the amount left free Milk cheese, gelatin and eggs are preferable to meat because the extractive content of meat has a stimulating effect Fat tends to depress the secretion of gastric juice, and, hence, decreases the outpouring of the acid Concentrated foods, such as sweets extremely hot or extremely cold foods which are stimulating, pastries fried foods, and hot breads which are difficult to digest, and alcohol are contraindicated Coffee and tea in moderation are

permitted Treatment also includes a search for the probable contributory cause and its alleviation which in turn will relieve the stomach acidity

The reverse condition known as **hypochlorhydria** (hypoacidity and achlorhydria the absence of hydrochloric acid in the stomach) likewise occurs and is related to a number of such clinical conditions as Addison s disease pernicious anemia chronic alcoholism and myxedema Indigestible residue in the diet is reduced to a minimum and easily digested nonirritating foods are included to decrease to a minimum the work of the stomach Fat is reduced to a low level because of its depressing effect Meat juices and fruit juices which tend to stimulate gastric juice flow are used In this condition other gastric enzymes may be deficient or absent (achylia gastrica) It is then essential that foods which will leave the stomach quickly be given so that fermentation cannot take place Here it must be remembered that attractive savory palatable food is conducive to a copious flow of gastric juice and that the act of chewing also sets up preparatory changes in the gastrointestinal tract Crisp toast or crisp bacon or other foods which require chewing but which leave no residue are of value in initiating peristaltic waves

Gastritis, acute or chronic is an inflammation of the mucous membrane of the stomach By use of a gastroscope the stomach lining is seen to have undergone changes like those seen in other inflamed mucous membranes

The cause of gastritis is not clearly defined but it may be from dietary faults such as rapid eating improper chewing it may be due to excessive alcohol or drugs or indirectly to a disease condition elsewhere such as pulmonary tuberculosis syphilis cirrhosis of the liver nephritis myocardial failure and polyarthritis In addition acute gastritis may result from some ingested poison

Dietary treatment is based on the same rules which govern any modifications of the normal diet—recognition of the abnormality and adjustment of the diet to it with precaution against development of a deficiency It is recommended by some that patients with acute gastritis refrain from ingesting any food for one or two days Then a full fluid diet that combines the physical modifications for a fluid diet with the chemical modifications

of a bland diet follows. The next step usually consists of a smooth bland diet, similar to the one found in Table 98. This diet is the most commonly used in chronic gastritis. Further adjustment may be necessary if either hypoacidity or hyperacidity exists. In addition, any possible correction of dietary faults that exist which may intensify the condition is made. These could include meals eaten slowly, food thoroughly masticated, and an elimination of those foods that had been found irritating (very hot foods and very cold foods, for example, are frequent offenders).

Ulcers, gastric and duodenal, receive the same dietary treatment. In the United States about ten times as many ulcers are duodenal as are gastric. Hyperacidity occurs in the majority of cases. As a rule, regardless of whether the ulcer is stomach or duodenal, it is located near the pylorus, and healing of a break in the mucous membrane is difficult because of the ever-present peristalsis and contraction and relaxation of muscles. The affected region is not only in constant motion but is constantly bathed by digestive juices and partially digested food. Even if the last factor could be eliminated, the other two would still remain For this reason, fast periods and the use of duodenal tubes designed to pour the food directly into the intestine below the point of trouble are less satisfactory than might be expected.

The problem, then, is to provide an entirely adequate dietary which will not irritate or stimulate the affected part The underlying principle is to provide a diet that is "chemically, mechanically, and thermally nonirritating."* Thus, chemically irritating foods that should be eliminated from the diet may be such items as spices, meat extracts, rare meats, condiments, vinegar, and so forth; mechanically irritating foods may be those that contain indigestible fiber, raw fruits and vegetables, tough fibers in meats, bran and whole grain cereals; and thermally irritating foods refer to extremely hot or cold beverages or desserts.

A second underlying principle is to provide foods that will neutralize the excess hydrochloric acid. Protein foods, especially milk and egg, will do this. In addition, fat has a depressing effect on hydrochloric acid. In order to maintain the neutralization of the gastric contents, frequent feedings are necessary.

*Turner. Handbook of Diet Therapy, J. B. Lippincott Co., p. 125

These may be hourly, as in the case of severe ulceration, or, as the ulcer is brought under control, it may be only six small meals daily An adjunct to food in maintaining neutrality is the administration of alkaline powders The type of "alkaline powders" and the method of their use vary considerably with physicians, and will not be described here Belladonna in some form is also frequently used

These principles give the basis for the ulcer diet, the milk cream diet so well known as the Sippy diet (sometimes spelled Sippi) This diet consists of equal parts (45 gm) of milk and cream every hour for one week, then the gradual addition of cereal, cream soup custard or junket at two of the feedings the second week During the third week further additions are made, and so on (See Table 97) By the end of three to six weeks on the Sippy regime, depending upon the severity of the condition, the patient has had his diet increased from the liquid diet to the soft diet, is permitted to resume work and takes his food as three main meals a day with between meal feedings He should continue to avoid such foods as raw fruit (except juices) and raw vegetables nuts spiced or highly seasoned foods, fried, rich, and excessively sweet foods or those which retard digestion, and alcohol

TABLE 97

Three ounces of a mixture of equal parts milk and cream are given every hour from 7 A.M until 7 P M After two or three days soft eggs and well cooked cereals are gradually added, until at the end of about ten days the patient is receiving approximately the following nourishment 3 ounces of the milk and cream mixture every hour from 7 A M until 7 P M and, in addition, three soft eggs one at a time, and 9 ounces of a cereal, 3 ounces at one feeding, may be given each day The cereal is measured after it is prepared

Cream soups of various kinds, vegetable purées, and other soft foods, may be substituted now and then, as desired The total bulk at any one feeding while food is taken every hour should not exceed 6 ounces Many of the feedings will not equal that quantity The patient should be weighed If desired and tolerated, a sufficient quantity of food may be given to cause a gain of two or three pounds each week

A large variety of soft and palatable foods may be used, such as jellies, marmalades, custards, creams, etc The basis of the diet, however, should be milk, cream, eggs, cereals, and vegetable purées Lean meat is not given during the period of accurate observation, since it interferes with the tests for occult blood in the stool and aspirated stomach contents

TABLE 98

ILLUSTRATIVE BLAND DIET

General Rules

Small frequent feedings
Avoid extremely hot and extremely cold foods
Avoid highly seasoned foods and foods mechanically irritating

Include these foods each day

Milk—at least one pint—buttermilk, whole or skim milk
Meats, poultry, or fish—4 oz as tolerated—tender, well done, broiled or roasted, without skins and tough connective tissue, may be minced
Cheese—cottage, farmer, or cream
Eggs—at least one, poached, soft or hard cooked, or scrambled in double boiler
Bread, cereal, cereal products—4 or more servings, cooked refined enriched cereal, enriched toasted bread, crackers from refined flour, macaroni, noodles, spaghetti, refined rice
Potato—one serving, white potato, mashed, baked (served without skin), boiled, scalloped, creamed
Vegetable, green leafy—one serving, tender cooked (if tolerated) or puréed
Vegetable other—one or two servings, tender cooked (if tolerated) or puréed
Fruit, citrus—one serving strained orange juice, usually diluted with water
Fruit, other—one or two servings, ripe banana and avocado, canned or cooked fruits, without tough skin or seeds, purée fruit or dried fruit
Fat—butter, cream, fortified margarine
Miscellaneous—cereal beverages, decaffeinated coffee angel food or sponge cake, plain cookies or puddings, salt, gelatin, half milk half coffee, cream soups made with puree vegetables, sugar in moderation

Omit these foods

Meats, poultry, fish—fatty, tough, rare, fried, salted smoked or highly seasoned
Cheeses—strongly flavored, highly salted
Eggs—fried
Breads, cereals and cereal products—whole grain, bran, quick breads, bread not toasted, dry cereals
Potato—fried potato skins, fibrous yellow potatoes, potato chips
Vegetable—raw fibrous, or tough skins and seeds highly seasoned
Fruit—raw (other than avocado or banana) skins and seeds
Fat—vegetable oils, meat fats, salad dressings, fried foods
Miscellaneous—meat extracts gravy broth, concentrated sweets candy, jelly, jam, sauces (other than white sauce), condiments, herbs, spices, vinegar, nuts pickles relishes, foods preserved in salt, cakes pastries carbonated drinks alcohol coffee tea, cocoa

There are a number of diets for use in ulcer Einhorn feeds a formula of 240 c c of milk, 1 raw egg, and 15 gm of lactose every two hours for 8 feedings by duodenal tube Lenhartz uses milk egg mixture every hour for five days then gradually adds scraped beef, boiled rice, toast, etc Coleman advocates a diet of glucose

TABLE 99

ILLUSTRATIVE CONVALESCENT ULCER DIET

General Rules

- Six small meals each day
- Avoid extremely hot and extremely cold foods
- Avoid highly seasoned foods and foods mechanically irritating

Include these foods each day

- *Milk*—at least one pint (usually one quart)—buttermilk, whole milk milk drinks
- *Meats poultry, or fish*—4 oz tender well done, broiled or roasted meats as tolerated, bacon, sweetbreads; white fish, canned tuna or salmon
- *Cheese*—cream, cottage or farmer, American used for flavoring or as tolerated
- *Eggs*—at least one, poached, soft or hard cooked, or scrambled in double boiler
- *Bread, cereal, cereal products*—4 or more servings—cooked refined enriched cereal, enriched toasted bread, crackers from refined flour, macaroni noodles, spaghetti, refined rice
- *Potato*—one serving white potato, mashed, baked (served without skin), boiled, escalloped, creamed
- *Vegetable, green leafy*—one serving tender cooked
- *Vegetable, other*—one or two servings tender cooked, puree of corn and Lima beans
- *Fruit, citrus*—one serving strained orange juice, others as tolerated
- *Fruit, other*—one or two servings—ripe banana and avocado; canned or cooked fruits without tough skin or seeds, puréed fruit or dried fruit
- *Fat*—butter cream, fortified margarine vegetable oils as tolerated
- *Miscellaneous*—weak tea and coffee, or half milk half coffee, cereal beverages, decaffeinated coffee, weak cocoa, angel food or sponge cake plain cookies, puddings made from the above foods, gelatin, cream soups made with puréed vegetables, plain candy, sugar, syrups, clear jelly in moderation

Omit these foods

- *Meats, poultry fish*—tough, rare fried salted, smoked, or highly seasoned
- *Cheeses*—strongly flavored, highly salted
- *Eggs*—fried
- *Bread, cereals and cereal products*—whole grain, bran, quick breads, bread not toasted, dry cereals
- *Potato*—fried, potato skins, fibrous yellow potatoes, potato chips
- *Vegetable*—raw, fibrous, or tough, skins and seeds
- *Fruit*—raw (other than avocado or banana), skins, and seeds
- *Fat*—meat fats, salad dressings, fried foods
- *Miscellaneous*—meat extracts gravy broth sauces (other than white sauce), condiments, herbs spices, vinegar, nuts, pickles, relishes, foods preserved in salt cakes pastries carbonated drinks, alcohol, jam, marmalade, and large amounts of concentrated sweets, such as candy jelly syrup and sugar

olive oil, egg white, salt, and water Seale Harris uses a diet similar to the Sippy, but includes orange juice at regular intervals with the milk and cream mixture The addition of orange juice supplies the vitamin C so essential for the healing process

A modification of the Sippy diet is the method most generally used. As a rule, the patient should stay in bed for three to four weeks. Feeding is begun immediately without any preliminary starvation period. Some hospitals have a progression of diets, called by such names as Bland Diet I, Bland Diet II, Bland Diet III, and so on. While the Sippy form of treatment is excellent medical procedure, it must be individualized the same as any other diet to meet the needs and pleasure of the patient.

One disadvantage of this diet is the marked deficiency of ascorbic acid, a vitamin so essential for tissue healing. It is also low in thiamine, riboflavin, niacin, and iron. In addition, it requires sodium chloride if mineral balance is to be maintained under calcium carbonate therapy. Pollack and Halpern (in *Therapeutic Nutrition*, NRC Bulletin No. 234) point out that the conventional diets used for the initial treatment of peptic ulcer are inadequate both in proteins and in calories. To illustrate further they estimate that the first week's menus for a typical modified Sippy diet provide only 50% of the protein requirements of a healthy individual. The menus that are used later in the treatment of ulcers may contain just 75 to 80% of the recommended daily protein and calorie allowances In order to supply the protein necessary for the treatment of peptic ulcer, Pollack and Halpern suggest that the patient should receive a minimum of 100 gm. of protein a day. They recommend that this can be accomplished by adding protein concentrates to the milk and cream feedings.

Alvarez states that while the Sippy diet brings good results, it is too elaborate for general use and requires more than meager intelligence or ordinary nursing care to follow it. He has devised an ambulant form of treatment which can be followed by the patient who is up and about. It is particularly adaptable to the patient with duodenal ulcers which are less prone to become malignant than are gastric ulcers. Alvarez permits his patients to remain at work and to have three meals a day, the smooth, nonirritating meals essential in any gastrointestinal lesion. Between meals the patient receives a feeding of the following mixture: 1 quart of milk, 2 eggs, ½ pint of cream This may, in part, be taken to work for a midmorning and a midafternoon meal, and the remainder may be consumed in the two evening snacks, or one in the night if the patient awakens If the mixture is

not available at the correct time Alvarez advises a milk shake or malted milk at a soda fountain or a dozen malted milk tablets The patient must do no heavy work such as lifting or gardening neither must he enter into any recreational activities other than walking Supplementation of the diet by commercial vitamin products is usually desirable and experience has shown that a vitamin intake well above normal (approximately double) is advisable Because fruits and vegetables are drastically curtailed in this diet there is danger of deficiencies of the vitamin B complex vitamin C and possibly vitamin K

Other methods of treatment of peptic ulcer have been reported in the literature recently One is a regimen of frequent medication by the administration of several tablets which allows the patient to enjoy an unlimited diet Banthine an anticholinergenic drug has received support from some clinicians This is administered orally The existence of an antipeptic ulcer vitamin or factor has been reported It has been called vitamin U and seems to be present in several raw foods cabbage other green vegetables milk butter and egg yolk This factor is quickly destroyed by heat and has been found by Cheney to be related to the formation and healing of ulcers These are all encouraging steps in the treatment of peptic ulcer so that soon the usual regimen may include these newer methods

Recurrences of ulcers are not infrequent in individuals who considered themselves cured and had resumed the completely normal diet Prevention of recurrence should also include mental peace so far as it can be attained adequate rest and avoidance of violent exercise Fatigue emotional upset and infection are causes of the frequent recurrence of ulcers Incessant care and adherence to the necessary rules of health are important for all ulcer patients

If hemorrhage occurs rest is imperative physical mental and alimentary Sedatives will probably be necessary Just how long food must be withheld is a question Some authorities believe that nothing should be given by mouth until all bleeding stops and others contend that frequent feedings neutralize the gastric juice and prevent the juice from digesting the forming blood clot Meulengracht following this latter viewpoint recommends a diet of small frequent feedings of puréed meat cooked fruits pureed vegetables cooked cereals eggs and milk from

the first day of hemorrhage Others would use a neutralizing drip (by means of a Levine tube) to prevent clot digestion and withhold food which might dislodge the clot Still others prescribe feedings of milk gelatin and possibly orange juice until they believe a clot has formed and more food may be tolerated

The type of treatment will vary with severity of the condition its source the age and general health of the patient Surgery may need to be employed Postoperatively the ulcer patient may have to limit his menus to small frequent feedings of simply prepared foods His diet will depend upon the extent of the surgery and the condition of the patient

Cancer in the gastrointestinal tract requires the same treatment as any other type of lesion although as time passes and the condition becomes progressively worse the liquid type of diet rather than increased food intake will probably become the order Diet intake for the greatest comfort of the patient should be the rule Smaller meals at more frequent intervals are usually the preferred course The regime will be governed by location of the lesion stage of advancement whether surgical intervention is practical and the nature of the functional disturbance and secretory disorder Varying degrees of obstruction may exist diminution of motor activity hyperacidity or hypoacidity Anorexia is frequently present therefore palatability variety padding and attractiveness in service play an important part Unless contraindicated the personal likes and dislikes of the patient should be given every attention

Pylorospasm Just as spasm may occur at the cardiac end of the stomach it may occur at the pyloric end and prevent normal passage of stomach contents into the intestine with resulting stagnation gas formation and distention due to dilatation of the stomach (gastrectasis) A stenosis or constriction of the pylorus from any cause will bring about this same result Surgical intervention is usually necessary and small frequent feedings of nonstimulating nonirritating soft foods accompanied by daily lavage (washing) of the stomach give relief and are the practice often necessary in preparing a patient for surgery

Disorders of the Small and Large Intestine

Nervous indigestion has been defined by McLester and Darby as a functional disorder of the gastrointestinal tract the main

festations of which are many and varied these may be the expression of chemical motor or purely sensory disturbances" Thus nervous indigestion is considered to be just one part of a total complex psychoneurosis There are many situations which may upset a person's nervous imbalance such as overwork grief and a severe illness The dietary treatment is just one part of the total care of the patient Of course the diet must be nutritionally adequate yet making adjustments for those specific foods that the patient believes he should avoid He should be persuaded to cautiously add the "offending foods to his menus until he is convinced that he can eat all foods Although adjustments should be made initially the diet should not be restricted too rigidly Obviously treatment has to be prescribed individually Some patients may benefit from pureed foods until they can progress to a more normal regime McLester and Darby point out that the directions should be explicit not general or vague and that they should never be in a printed diet slip but the patient should feel they are individually given

Flatulence or gas formation is a distressing and frequently found symptom It occurs in health and in various disease conditions Excessive gas production inadequate expulsion or faulty absorption may be underlying causes The habit of 'gas swallowing' bacterial action allergy loss of intestinal tone and secretion of blood gases into the intestinal tract all contribute to this condition Certain foods are known to be gas forming in some individuals but not in all Cabbage cauliflower Brussels sprouts turnips onions and the legumes are gas producing and are rich in hydrogen disulfide (H_2S) Melons spinach cucumbers radishes and raw apples are also in this category Carbonated waters and mineral waters may cause discomfort Molasses honey and maple syrup and maple sugar are also offenders All these foods may at times be valuable because of this very property for gas leavens the fecal mass and is an aid in combating constipation A specific food may be gas forming for the individual patient at one time and yet may eat it without discomfort at another time This seeming inconsistency may be due to factors other than the gas forming element within the food itself such as an emotional upset or a temporary illness

Correction of flatulence requires elimination of the offending foods, or perhaps just an improved method of cooking. Hughes reports studies on healthy adults with whom certain foods disagreed, and found cooking methods to be an important factor. Overcooking, with resulting formation of decomposition products, definitely increased the number and intensity of the symptoms. Retention of volatile acids, by cooking the food in a covered kettle, also favored the decomposition of the sulfur compounds. Cooking vegetables until just tender not only preserves vitamin content but increases the digestibility. For maximum preservation of vitamin content, cooking vegetables in a small amount of boiling water in tightly covered vessels is the approved method and should be strictly adhered to except in cooking "strong-flavored," or more accurately, "sulfur-containing" vegetables. With such vegetables, vitamin loss is sacrificed to digestibility.

The use of a soft-low fiber diet reduced somewhat in carbohydrate, and from which rich foods and concentrated sweets are eliminated, may also be of value. The diet described in Chapter 27 is well adapted here. Eating and health habits, and psychic factors should be examined critically as possible contributors to the condition.

Diarrhea is a condition characterized by too frequent stools with more fluid consistency than normal. There is inadequate absorption of water by the body as the intestinal contents pass with unusual rapidity along the tract, or there is outpouring of water into the colon. Diarrheas are described as functional and organic. Kantor classifies the functional diarrheas as those which may occur in the normal person whose intestinal tract is exposed to an irritant, or who is allergic. They may occur as the result of putrefaction or fermentation, achlorhydria, endocrine disturbance, sprue and pellagra, nervousness, and a compensatory type associated with uremia or cutaneous burns. The organic diarrheas are caused by bacterial or protozoan invasion, poisons, and diseases, such as ulcerative colitis and regional ileitis.

The character of the stool, as determined grossly, microscopically, and chemically, gives evidence of the type of diarrhea and the causative agent. When these are known, the diet may be adjusted to combat or correct the abnormality. While gross examination does not always differentiate, a foul-smelling, dark

brown alkaline stool, for example, is, in general, due to putrefaction (proteolytic decomposition), and a light yellow acid stool showing gas bubbles is probably due to fermentative action on carbohydrate. In some cases the Schmidt Test Diet is frequently used for such diagnosis. It is usually given for about three consecutive days. It contains approximately 110 gm. of protein, 105 gm. fat, and 200 gm. of carbohydrate which totals about 2,200 calories. (See Table 100.)

TABLE 100

SCHMIDT TEST DIET

Breakfast	
	1 pint of milk*
	50 gm. of zwieback
Midmorning	
	1 pint of oatmeal gruel
	40 gm. rolled oats
	10 gm. butter
	200 gm. milk
	300 gm. water
	1 egg
	salt
Lunch	
	125 gm. chopped or scraped beef (raw weight), broil with
	20 gm. of butter
	250 gm. mashed potatoes
Midafternoon	
	Same as breakfast
Supper	
	Same as midmorning

*If patient does not tolerate milk well, substitute the following:
1 liter cocoa
20 gm. cocoa powder
10 gm. sugar
400 gm. water
100 gm. milk

Putrefactive diarrhea resulting from bacterial action on protein requires a high carbohydrate, low protein diet. If the diarrhea is caused by fermentation, however, the diet should be high protein and restricted carbohydrate. A fatty stool is indication of an inability to utilize fat normally. If starch particles are present, starch must be restricted and a higher protein-fat diet used. Only general rules can be given including the use of smooth, nonirritating, concentrated diets if the condition is chronic. Liberal fluid intake must be provided to prevent dehydration. Vitamin and mineral adequacy can be assured only

by increased intake, as in the rapid passage of matter in the intestine normal absorption cannot take place Mucosa integrity must be maintained in spite of altered intestinal contents and *motility* Vitamins are important for this purpose

In acute diarrhea, water and minerals are important considerations, and both must be *taken in liberal amounts* *The diet* should be drastically limited, and nothing should be given by mouth during the first twenty four to forty eight hours except water, tea, or broths After this, gruels, baby foods, cream soups, and milk which has been boiled (to reduce the size of the curd) are all well *tolerated* *Some physicians prefer not to include* milk in the list Later, tender meat may be added to the diet Fats, fruits, and sweets are contraindicated during an acute attack because of their laxative action As the patient improves, the soft diet becomes the diet choice and is followed by additional *food until the normal diet may be tolerated*

If the diarrhea is of the nervous type, treatment must be directed toward removing or relieving the cause, which may be psychic or due to mental or physical strain

Frequently diarrhea, either chronic or acute, is a complicating *symptom in nephritis, diabetes, paratyphoid infection, cholera* or other intestinal infection or may be due to inorganic poisons, such as arsenic, mercury, iodide, or antimony It may result from an allergy or from an overindulgence in food, or food that is laxative in nature or has been contaminated The causative factor and also the extent of tissue involvement will determine the corrective or alleviating diet But, in general, the regime given should prevail (see following discussion of Colitis) Sedatives, antispasmodics, and constipating medicine may or may not be necessary Bed rest during an acute attack is mandatory

Mucous colitis is regarded as a disorder primarily of the nervous system which manifests itself in the intestinal tract due to instability of neuromuscular control The term mucous colitis is used because large quantities of mucus are *passed in the* stools Constipation is usually present The diet suggested in this disorder is a well balanced, smooth nonirritating diet which derives its bulk from soft indigestible fiber (see Chapter 7) rather than from the use of large quantities of vegetables and cereals *Agar likewise provides a smooth residue* The diet

should consist of milk cream eggs tender meats fruit juices pureed vegetables and either white or wheat germ or vitamin B reinforced bread which is devoid of all bran (see Cereals Chapter 3) The vitamin intake must be adequate and the vitamin B complex intake must receive special attention because of the curtailment of whole grain cereals A commercial source of the B complex will be of value for instance Vegex a yeast preparation which fits easily into the dietary as a food product

Ulcerative colitis a serious form of this disease affects the large intestine Its cause is unknown It may be an infection an allergic manifestation or a nutritional deficiency These theories all have support The disease naturally is intensified by emotional upsets inasmuch as an intimate relationship exists between emotional disorders and digestive functions The mucosa is first edematous and diffusely hyperemic (excessive amount of blood) it bleeds readily Later small abscesses form rupture and bleed The entire colon may be involved The symptoms appear insidiously with periods of remission and activity Diarrhea and constipation accompany the disorder and once it is established it tends to become chronic

The treatment entails prolonged bed rest a soft low fiber diet high in protein (150 gm) high in vitamins (double or triple normal intake) high in minerals and otherwise adequate Malnutrition and anorexia are usually encountered Occasionally sensitivity to certain foods develops unfortunately often to milk eggs oranges tomato and wheat If milk is well tolerated the basic diet may well include two quarts daily Padding with powdered milk may be used if the two quart bulk is too great To compensate for the increase in protein fats should be curtailed Commercial vitamins are employed Hypovitaminosis due to faulty absorption has been suggested as a cause for continuance of the disease Liver extract has been shown to have distinct value in some cases

During acute stages of the disease the diet must be limited to liquids It then progresses according to the condition of the patient through the soft diet to the diet for convalescence and in this form it is continued for life Trial and error with intelligent watchfulness on the part of the patient in cooperation with the physician and ruling out of possible allergies is the wise method of adjusting the diet Individual tolerances vary from

time to time, and individuals differ in regard to the foods which may be gas-forming. Tolerances for fats and starches vary with the individual also.

Constipation is probably the most common of these disorders, and it causes much needless worry. The idea that to be normal there should be a daily bowel movement has often led to the harmful practice of catharsis. Many individuals remain in perfect health with but one bowel movement every two or three days. Others may have several movements in one day habitually, with no indication of diarrhea. The amount of fecal matter passed daily varies considerably (100 to 400 gm. of moist fecal matter; see Composition of Feces) and is dependent somewhat upon the food ingested.

The idea has prevailed that when fecal matter remained in the body for several days, poisons were absorbed from it and caused the feeling of discomfort experienced in constipation. Alvarez points out that if absorption of poisons (autointoxication) were the cause of this discomfort, the symptoms would not disappear immediately upon defecation, as they always do, any more than one could "sober a drunken man by taking the bottle from his hip pocket"—a rather homely but well-pointed statement. The discomfort in constipation is probably of nervous origin from pressure on the mucous membrane, on the pelvic nerves, and perhaps slowing up or halting of normal peristalsis.

Intestinal autointoxication is a much abused and vaguely used term, indicating that poisons elaborated in the intestine are absorbed by the blood and passed through the circulation, leaving a trail of ills. The theory is that protein is the chief offender, and that the indican of the urine is a measure of the intensity of the reaction. As a matter of fact, poisons which are found in the intestinal tract are normally destroyed either in the intestinal mucosa or in the liver (see Chapter 37, discussion on functions of the liver). Alvarez, in his review of the subject of intestinal intoxication as a cause of disease, is quoted by McLester as offering the Scottish verdict of "not proved with an evident leaning toward not guilty."

McLester outlines the causes of constipation according to the classification of Spencer: (1) Dietary faults, deficient residue, or deficient liquid intake. (2) Interference with normal defeca-

tion reflex by lack of response or from injury to the nervous system as in tabes dorsalis or when defecation is painful as in fissures or hemorrhoids (3) The habitual use of laxatives and cathartics which frequently defeat their purpose by bringing on intestinal spasm from their irritating and inflaming qualities If the purge is too drastic the entire large intestine is emptied and no material remains for evacuation the following day Normally a certain amount of fecal material remains in the ascending colon and usually in the transverse colon after each evacuation (4) Lack of exercise which leads to weakness of skeletal muscles and lowering of tone Any change in neuromuscular control of the bowel may lead to constipation (5) Stasis which from any cause allows time for extraction of abnormal amounts of water from the fecal mass so that a hard fecal mass results (6) Spasm of the intestine as a result of abnormal irritability or the presence of irritating material or both Psychogenic influences may be a factor in this type of constipation

Constipation may be classified in three general groups atonic spastic and obstructive The terms are self explanatory

In **atonic constipation** there is decreased muscle tone The diet must be planned to stimulate the colon to evacuate normally In the majority of cases this is best accomplished by foods with high indigestible fiber content foods which will swell and retain their moisture such as agar foods which will act as lubricants fats and oils in general gas forming foods which will lighten the fecal mass and stimulate by pressure and through abundance of water Vitamin intake should be adequate especially the vitamin B factor which has specific effect on intestinal tone Nicotinic acid and pantothenic acid are reported to be concerned with intestinal motility hence are important in this condition also The establishment of regular habits of evacuation is advised and exercise to increase muscular tone

Spastic constipation is essentially the opposite of the atonic type In this condition the colon is subject to contractions or spasms accompanied by pain This increased irritability may be the result of excessive use of laxatives or enemas overingestion of condiments alcohol or of foods which leave a harsh roughage such as bran (see discussion in Chapter 7) A diet planned to stimulate as little as possible the highly sensitive intestinal mucosa is used in this disorder Logically it will be a smooth diet

devoid of spicing and condiments, it will include no gas forming foods or stimulating foods, and at the same time it will be adequate for optimum nutrition. In some cases high fat diets are of value but not in cases where alternating diarrhea and constipation occur. The organic salts and acids of fruits have a mild laxative and stimulating effect on peristaltic action and may be used liberally in this type of constipation. Excess use must be guarded against to prevent overlaxation. Table 101 shows how a normal diet may be adjusted for a patient with atonic constipation and a patient with spastic constipation.

Obstructive constipation results from a block of varying degrees of completeness and necessitates surgical intervention. Until operation takes place, the diet must be without residue and must not be gas forming. The liquid or soft diet is used.

TABLE 101

ILLUSTRATIVE MENUS FOR TWO TYPES OF CONSTIPATION

ATONIC CONSTIPATION	SPASTIC CONSTIPATION
Breakfast	
Orange sections	Orange juice
Oatmeal with cream and sugar	Farina with cream and sugar
Whole wheat toast, butter	Enriched white toast, butter
Coffee, cream, sugar	Coffee, cream, sugar
Lunch	
Cream of celery soup	Cream of celery soup
Sandwich	Cooked vegetable plate
Whole wheat bread	Spinach
Lettuce, bacon, tomato	Julienne carrots
Mayonnaise	Cauliflower flowerettes with cheese sauce
Carrot sticks	Escalloped tomato
Fresh fruit cup	Toasted enriched white bread
	Butter
	Baked apple—with cream
Milk	Milk
Dinner	
Tomato juice	Tomato juice
Roast beef, gravy	Roast beef
Baked potato, butter	Baked potato, butter
Broccoli with hollandaise sauce	Buttered string beans
Lettuce wedge with dressing	Sliced banana salad
Whole wheat bread, butter	Enriched white bread, butter
Sponge cake	Baked custard
Coffee, cream, sugar	Coffee, cream, sugar
8 P.M.	
Cheese crackers	Plain cookies
Milk	Milk

Occasionally it becomes necessary to prescribe a diet low in residue for the patient. This may be when it is undesirable for fecal material to enter the large intestine, either because of infection or, usually, as part of the regime following an operation on the colon. It is difficult to administer a low residue diet and there is little general agreement as to what may constitute such a diet. However, Table 102 lists foods that are considered by many to be low in residue and also those foods that are usually

TABLE 102

ILLUSTRATIVE LOW RESIDUE DIET

Include these foods each day

Milk

Meats, poultry, fish—4 oz. tender, well done, broiled or roasted beef, veal, lamb, chicken, turkey, or fish, bacon, canned tuna fish and salmon

Cheese—cottage cheese, cream cheese, American cheese used for flavoring

Eggs—at least one, poached, soft or hard cooked, or scrambled in double boiler

Bread, cereal, cereal products—4 or more servings—cooked refined enriched cereal, enriched white bread, crackers from refined flour, macaroni, noodles, spaghetti, refined rice

Potato—one serving white potato, mashed, baked (served without skin), boiled, escalloped, creamed

Vegetable—green leafy—at least one serving, canned, cooked, or frozen vegetable purée

Vegetable, other—one or two servings vegetable juice, canned, cooked, or frozen vegetable purée

Fruit, citrus—one serving of strained fruit juice

Fruit, other—one or two servings of strained fruit juice, ripe banana or avocado, canned or cooked fruits without skins or seeds, puréed fruit or dried fruit

Fat—butter, fortified margarine, cream, oils, mayonnaise

Miscellaneous—gravy, salt, vinegar, clear candy, jelly, molasses, sugar, syrup, bouillon, broth, angel food or sponge cake, plain cookies, gelatin desserts, coffee, tea, cereal beverage, carbonated beverage

Omit these foods

Milk—some omit milk, ice cream, puddings from milk

Meats, poultry, fish—fresh pork, clams, oysters, fried meat or fish

Cheese—any cheese other than those listed above

Eggs—fried

Breads, cereals, and cereal products—whole grain, bran, crackers and breads made from whole grain flour

Potato—fried, potato skins, potato chips

Vegetable—raw, whole cooked

Fruit—raw (other than avocado or banana), canned, cooked or dried fruits with skins and seeds

Fat—meat fats, salad dressings (other than those made from ingredients above)

Miscellaneous—herbs, spices with residue, nuts, pickles, relishes, olives, jam, marmalade, candy containing fruit or nuts

excluded Usually, a low residue diet is given for only a few days It is inadequate in many nutrients, primarily vitamins and minerals

In reviewing the disorders of the gastrointestinal tract, it is seen that, in general, the principles for preparing the diets described in Chapter 27 cover all the adjustments needed It is a matter of *providing an adequate, well balanced diet of such consistency* and composition that it will be nonirritating, low in *residue, devoid of high seasonings*, and lacking in foods which are rich, gas forming, or slow to digest The need for vitamins to maintain epithelial integrity is now recognized in combating lesions of the gastrointestinal tract and in the beginning of these diets This fact must be kept closely in mind

Wilbur, in discussing the role of the gastrointestinal tract in conditioning deficiency diseases, reminds his readers that the gastrointestinal tract plays an essential role in obtaining and utilizing nutritive substances Not only the intake but the state of function of the gastrointestinal tract must be considered There may be diminution or loss of digestive secretions, inadequate absorption of the food nutrients, loss through vomiting, an external fistula or diarrhea, or alterations in metabolism requiring increased needs

In the treatment of any gastrointestinal disorder, these factors must be borne in mind and treatment adjusted accordingly Frequently, dietary means are not wholly adequate and commercial products must be used as supplements

Except where specifically indicated otherwise, from the standpoint of ease of preparation, economy, palatability, and the patient's enjoyment, it is preferable to prepare these diets by modification of the family dietary If the suggestions given previously are followed, this can readily be done Specific diet menus are generally unnecessary and should be avoided whenever possible A further advantage is that the adjusted diet, by conforming to the normal diet pattern is less liable to deficiencies If the suggestions given are followed, this can readily be done

In order to ascertain the specific character of a gastrointestinal disturbance, various procedures are used The test meal (Ewald) is composed of 250 c c of water or weak tea and 1½ ounces of dry toast, taken in the morning *on an empty stomach* Samples

of gastric contents are withdrawn at intervals to determine the extent of digestion and the efficiency of the digestive juices Material may also be withdrawn from the duodenum by use of the duodenal tube The speed with which food leaves the stomach may be determined by adding to an ordinary meal characteristic substances, such as berries with seeds or tea leaves Withdrawal of contents at intervals indicates the speed of evacuation

The time between ingestion and final elimination of food is determined by the ingestion of a "marker," such as carmine, glass beads, or charcoal, and watching for its appearance in the stool

Bismuth or barium may be added to a milk drink, and its passage may be followed the entire length of the tract by the fluoroscope and x-ray

Gastroscopes are employed for looking directly into the stomach, the proctoscope for inspecting the rectum, and the sigmoidoscope for examining the sigmoid flexure

Besides these methods, gross microscopic, and chemical analyses of the feces will determine their normalcy and frequently influence treatment

Review Questions

1 What general modification of diet is advised in abnormal conditions of the gastrointestinal tract?
2 When the tonicity of the stomach muscles is weak, what type of diet may be necessary temporarily?
3 What are the outstanding characteristics of the diet used to combat hyperchlorhydria?
4 What food adjustments are necessary in cases of hypochlorhydria?
5 What are the principles of dietary treatment generally accepted for patients with gastric or duodenal ulcers?
6 What are the differences in the diets recommended for acute and chronic gastritis?
7 What are some of the causes of constipation?
8 What three general types of constipation are recognized?
9 What are the principles of dietary treatment in each type?
10 What are some of the causes of diarrhea? What are the recognized types of diarrhea?
11 What are the principles of treatment in each type of diarrhea?
12 What are some of the underlying causes of flatulence?
13 What foods are likely to be gas forming for some individuals?
14 In addition to the elimination of the offending foods, what else may be done to relieve this condition?

Suggested Projects

1 Plan a diet for a 16 year old girl who has been placed on an ulcerative colitis regimen Be sure to meet the nutritional demands of this age group When planning the menu, make allowances for her "social" needs, such as afterschool snacks, and so on

2 Plan a convalescent ulcer diet for a 45 year old man who works in a factory and eats his lunch in the company cafeteria

3 Plan a week's menu for an 8 year old boy who has been suffering with acute diarrhea

4 Plan a diet for an adult man who is both diabetic and has peptic ulcers Assume his diabetic prescription is protein—70 gm, fat—85 gm, and carbohydrate—200 gm Keep in mind the specific needs of each condition

5 Plan a day's menu for a 45 year old woman, a homemaker who eats all her meals at home (lunch is eaten alone) who has been placed on a diet for atonic constipation

CHAPTER 36

CELIAC DISEASE

Celiac disease, found almost entirely in children, is a condition in which the patient is unable to absorb carbohydrates and fats. Its etiology is unknown. The primary treatment is the regulation of food. Protein is well tolerated and therefore provides the basis for the dietary regime. The rate and form in which other foods, carbohydrates and fats, are added to the diet differs considerably. However, most restrict both to a varying extent. Limitations in diet are usually necessary for many years.

Several hundred articles have appeared in the literature on the subject of celiac disease but as yet its etiology is unknown. Certain authors contend that tropical sprue, nontropical sprue and celiac disease are identical; others are sure that differences between these conditions exist. Further, debate surrounds the question whether the condition is due to faulty carbohydrate or faulty fat metabolism, whether it is an avitaminosis, an allergy or an endocrine disturbance.

Treatment of course depends largely upon the causative factor or factors which the physician considers dominant. In spite of the uncertainty, the gradual tendency has been toward the generally accepted type of diet outlined later in the chapter. Whatever may be the cause of the disease, this type of diet has proved to be clinically effective.

The disease "sprow" was first described by Ketelaer in 1669. He commented upon the feces "so copious that several basins or pots scarcely held these accumulations." The disease later became known as tropical sprue because it was believed to occur only in the tropics. Throughout medical writings descriptions occur. The classical description was given in 1888 by Samuel Gee who wrote "On the Coeliac Affection." Later, in 1908 Herter published a monograph "On Infantilism From Chronic Intestinal Infection." More recently, Howland, Haas, Fanconi, Parsons, and Thaysen have added materially to our literature on the subject.

The disease is known by a number of titles, intestinal infantilism Gee's disease, Heubner Herter disease, Gee Thaysen Huebner disease, etc

There is no information concerning the incidence of celiac disease It may occur from soon after birth until the fifth year of life Its appearance is usually gradual, however, when fully developed, among the principal symptoms, present completely or in various combinations is steatorrhea (fatty stools) either with or without diarrhea The stools are large, frothy,

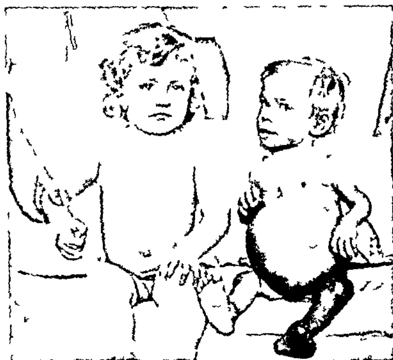


Fig 68 —These two children are the same age The obvious difference between the normal (left) child and the celiac child is characteristic of the disease (Courtesy Dr Curt Falkenheim)

foul smelling with a greasy oatmeal" appearance Large numbers may be passed in a day Gastrointestinal disturbances such as abdominal colic and gas, are frequent The stomach is greatly distended, the buttocks are shrunken and pendulous The fat stores are completely used up and there is extreme muscular atrophy Growth is stunted weight is lost, at times wasting may be marked The child is introspective hysterical, and unhappy, a source of misery to himself and to all those around him In his diarrheal periods the irritability may become extreme

Anemia and symptoms of calcium deficiency and avitaminosis appear. Gastric acidity is usually reduced and hypocalcemia is a frequent complication. The occurrence of infantilism suggests endocrine envolvement.

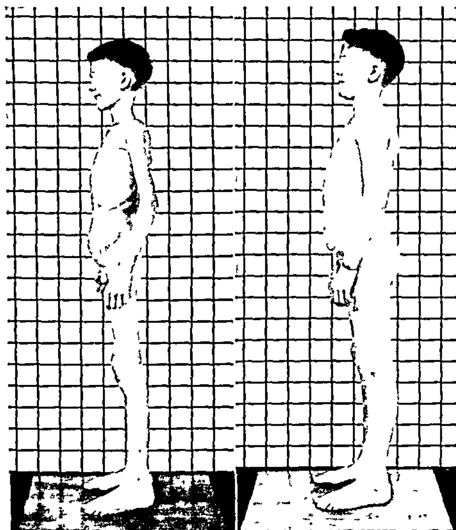


Fig 69—R C at 14 and 16 years of age during a celiac flare up and two years later The regimen followed during these two years was the diet described in Table 104

Other conditions possess symptoms similar to those manifested in celiac disease When diagnosing for celiac disease, it is important that these other conditions be eliminated One of the most similar is cystic fibrosis of the pancreas The latter condi-

tion also occurs in early infancy and childhood and it presents a clinical picture which may be identical with that of celiac disease In addition cystic fibrosis is associated with repeated and persistent upper respiratory infections There are also further distinguishing characteristics Haas commented that he believed if the patient with cystic fibrosis were treated in the same way as in celiac disease the diarrhea will cease nutrition become normal and if it has not become too severe the pulmonary infiltration may clear up

With the fatty stools there is upset in the calcium balance Calcium is excreted in the feces as calcium soap and there is increased urinary excretion of phosphorus These combine to bring about abnormal brittleness of the bones due to calcium and phosphorus depletion Calcium loss has been reported to be so severe as to result in tetany There seems to be delayed motility and alterations in the small intestine mucosa especially in the jejunum possibly with edema

These symptoms have led to several theories first that celiac disease is a specific and perhaps infectious disease of the small intestine which results in multiple nutritional deficiencies second that it is due to pancreatic or biliary insufficiency and third that it is a deficiency disease similar to pernicious anemia The last theory has led to the use of liver extracts folic acid and vitamin B_1 (see Anemias Chapter 40) with some encouraging results Another suggestion is that celiac disease is a pituitary dysfunction a failure on the part of the anterior lobe to produce sufficient prolactin (one of the hormones) to enable the gastrointestinal tract to function normally Other experience has indicated that an association exists between the celiac syndrome and gastrointestinal allergy and still other research suggests that the intestinal mucosa fails to absorb fats and carbohydrates in a normal fashion

Recently evidence by Dutch and American research has indicated that celiac patients react unfavorably to the gluten in wheat rather than to its *starch content* They further suggested that gliadin might be especially implicated and that rye too might be an allergen A study in which one of the authors is participating is undertaking to add to these data In one patient used in a pilot study the improvement on a wheat rye free diet was striking A group is now under investigation

Gee in his original discussion first suggested that To regulate the food is the main part of treatment If a patient can be cured at all it must be by means of diet Today, treatment is based on the same idea

The **dietary treatment** consists in recognizing the metabolic inability to utilize starch and fats normally Definite alteration in the ability to absorb these foods occurs Some place the the major emphasis upon the inability to digest and absorb the starches and others contend that the principal difficulty is with the fat metabolism Whichever abnormality predominates it is an established fact that both constituents must be adjusted The normal relationship of protein fat and carbohydrate must be changed As the condition of the patient improves this relationship may gradually readjust toward the normal

Haas states one basic principle of the diet in celiac disease which he believes must be established firmly and kept in mind constantly No food may be ingested by the celiac patient that contains an appreciable amount of carbohydrate other than that found in fruits and to a lesser extent in vegetables and in protein milk Other clinicians add small amounts of carbohydrate from sources such as cereal

Protein is well tolerated therefore in the acute stage proteins exclusively are recommended by some clinicians—protein milk padded skim milk calcium caseinate milk cottage cheese meats egg white gelatin etc Haas who has recognized the efficaciousness of banana adds a completely ripe (brown spotted) banana to this basic diet used in the acute stage The banana which is of low fiber content may be served raw or baked and from several to a dozen may be tolerated each day It is imperative that the bananas be ripe! Protein milk is available commercially or there are several methods of preparing protein milk in the home Three which have been found acceptable are included in Table 103

When the condition of the patient is improved cooked canned or the juice of fruits are added apple apple powder orange juice and other fruits These should be added cautiously and singly in order to ascertain if any adverse effects occur Fruits canned in sugar heavy syrup are usually contraindicated Vegetables low in carbohydrate value are added next then a limited amount of flaked or puffed cereal or thinly sliced toasted bread

TABLE 103

THREE METHODS FOR THE PREPARATION OF PROTEIN MILK*

I Protein milk prepared according to Finkelstein and Meyer
One quart of milk, warmed to temperature of 98° F To this is added one tablespoon of essence of pepsin Allow to drain through cheesecloth for one half hour to separate the whey from the curd The curd mixed with one pint of water is then rubbed through a fine wire strainer several times, and to it one pint of buttermilk is added The whey, which contains most of the sugar, is discarded

III Protein milk is prepared by Mueller and Kran
Mix one quart of buttermilk (commercial) and one quart of water and heat to a temperature of 135° F Remove from the stove and let stand for one half hour By this time the curd is well separated from the whey, 36 oz of which should be dipped off The remaining curd and whey are mashed through a fine sieve, and 4 oz of 20% cream or 4 oz from top of bottle milk, and enough water should be added to bring the mixture to 32 oz

III Powdered protein milk 12 tablespoons of the powder to 32 oz of water

IV Calcium caseinate milk Use from 4 to 6 tablespoons of calcium caseinate (Mead Johnson's Casec) to one pint of water and one pint of milk Mix the Casec with a little cold water (enough to form a smooth paste), pour in the remainder of the cold water Then pour in the milk and bring the whole mixture to a boil while stirring constantly and boil actively for one minute Remove from fire Let cool If necessary to sweeten, use one or two tablets of saccharine (1 gr)

*Haas S V and Haas M P Celiac Disease Philadelphia and London 1951 J P Lippincott Co pp 128 129

The last addition to the diet is the daily inclusion of an egg yolk It is true that egg yolk is a source of fat, but the fat content is less objectionable than the loss of its valuable constituents of the yolk—vitamins A and D, phosphorus, essential fatty acids, and lecithin The choline which lecithin yields has recently been recognized as a dietary essential When the diet has reached this point in variety, it is as it should remain until some better treatment becomes known

Haas has found that after a week on the basic diet of protein milk, etc, mentioned previously, orange juice, other cheeses including Swiss, cheddar, American and pot cheese, and egg may be added He suggests that these be added one at a time with sufficient interval to test the acceptability of each Then he suggests that after two weeks of this regime all fresh fruits may be tried in the same way Then, when the stools are controlled, vegetables (except potatoes and corn) may be introduced He has found that lettuce, squash, tomato, string beans, and carrots are well

tolerated Haas also allows some fat in the dietary management of celiac disease Fat in association with meats in the normal amount ' butter and in fat found in protein milk are allowed Usually sour cream can be eaten He may restrict fats at the beginning but when the celiac child is eating foods other than the basic diet the foods previously mentioned may be included Haas restricts all cereal grains including corn wheat rye or rice in any form ' whether as bread cake toast zwieback crackers cookies, or breakfast cereals Sugar is forbidden in any form which may include candy pastries breads corn syrup or as a sweetening However honey dates and raisins are permitted Milk in a form other than as protein milk is prohibited Other clinicians do not restrict the use of cereals and many do not allow fat in the diet

Recent research from Dutch workers van de Kamer and Weijers suggests that olive oil soybean oil and other unsaturated oils are better tolerated than butter beef fat and cocoanut oil in the diet of celiac patients

In most instances padding must be resorted to by the use of honey on toast the addition of powdered skim milk to liquid milk generous use of bananas malted milk the addition of gelatin to fruit juices and the like

Liver should be served once or twice a week It is a source of vitamin A and of the B complex and is effective in combating anemia from the standpoint of supplying a possible deficiency factor (see Pernicious Anemia Chapter 40) as well as combating the secondary anemia Liver preparations administered either by mouth or by injection (Chapter 40) may prove of value

Commercial sources of the fat soluble vitamins A and D must be given and perhaps also vitamins E and K The diet of the patient with celiac disease will not yield adequate amounts of the fat soluble vitamins because of the decreased absorptive ability of the intestine Vitamins and minerals must be above normal because of faulty absorption and symptoms of avitaminosis Pancreatin and bile salts may be of value in certain cases

Many clinicians suggest that the diet of the patient must also be low in residue in order not to overstrain the weakened and sagging gastrointestinal tract To reconcile low carbohydrate vegetables to a low residue diet will require the use of a strainer or

the choosing of those vegetables, or such parts of the vegetable, as would entirely or almost entirely pass through a strainer, as the flowerlets of cauliflower, the tips of asparagus, very tender young carrots, etc In addition, coarse veins must be removed from leafy vegetables, seeds and skin from fruits, and connective tissue from meat in order to adjust the bulk satisfactorily

It must be kept in mind that, although the celiac condition may be "under control," so that the patient is eating many more foods than he did when treatment began, he still must be on a restricted diet for a long time, a matter of several years in most cases indefinitely in many It is possible that a completely unrestricted diet can never be permitted Control rather than cure might be considered the objective of the diet The necessary alterations may be made in the diet and a diet should be planned which could be followed indefinitely, or until some as yet unknown factors are found Such a daily food list which might serve as a guide in planning a maintenance diet is given in Table 104

It is interesting that in checking over the diet with a large group of celiac patients—known for periods up to twenty years (the Rochester study)—the answers are usually similar They eat "everything now" and are fine—all cured However, further questioning usually elicits the information that they dislike fatty foods and frequently add they "never eat pastry and very little bread" They, like the "free" diabetic, have learned to take care of themselves Further questioning indicates there are bloating gas, and bouts of cramps They tire easier, cannot seem to gain weight, are easily discouraged, and frequently are anemic and nervous As the first patient in the Rochester study said, 'I did not know I really didn't feel well 'till I tried the new wheat rye free diet " May this be the answer we have been looking for? Does the improvement found by some on cereal free diets the gain on the protein diets, etc, result from the elimination of the wheat and rye proteins? If so, how much more easily the celiac patient of the future will be controlled

The work of May and his associates deserves consideration, it gives added emphasis to the value of liver extract and supplementary B complex These authors indicate that there is a decrease in the emptying time of the stomach, a slowing of the segmenting movements and dilation of the small intestine, all of which profoundly influence absorption Injection of crude

liver extract and of parenteral B complex, on alternate days resulted in improvement of the glucose and vitamin A absorption curves and in the motility of the gastrointestinal tract in from 3 to 6 weeks' time While they find improvement with this treatment, using the routine diet for the age of the patient, it would seem wiser to follow the celiac type of diet until further data are available However, emphasis on a higher B complex (containing a natural base) and crude liver extract therapy would seem sensible

The following dietary program has been found effective at Rochester (University of Rochester Medical Center)

TABLE 104

1 qt skim milk plus powdered skim milk—the amount added should be governed by calories required up to doubling the concentration of the milk—roughly 1 oz (4 level Tbsp) to 8 oz (1 cup) water results in a "reliquefied" milk

1 whole egg

Two servings:
- Meat—beef chicken, lamb veal, or pork devoid of visible fat
- or
- Fish—light colored (low fat content) only
- or
- Liver—calf, beef pig lamb, or chicken

Banana—3 plus, fully ripe (brown spotted) or dried banana products

Orange—medium size

Another fruit—apricots, peaches, apples, pears, etc

Vegetables—2 servings—tender carrots, asparagus tips, broccoli, small green beans, squash spinach (strained), cabbage (hard veins removed), tomato juice and vegetables juices, etc

*Cereal—1 small serving—corn flakes, grape nut flakes, and other "flaked or puffed" cereals

*Breads—*melba toast* only—not more than 3 *thin* well toasted slices

Cottage cheese—skim milk cheese only

Puddings as powdered skim milk, Casec, protein milk, gelatin, or honey

A commercial source of vitamins A and D

Probably a commercial liver product—some of these (Chapter 40, The Anemias) contain the vitamin B complex in addition to liver

If c- ... ould ... al

*In tl ... ickwheat tar i ... be made from oth ... s should watched for

Anderson in her 1947 paper on the "Celiac Syndrome," feels that fat intolerance is transitory and variable—that the in

ability to handle starch is the more serious phase In her studies she finds gastric hypoacidity and low pancreatic amylase She, too, stresses heavy vitamin therapy but uses the oral route

To repeat, the cause is still not clear, however, dietary adjustment, such as that outlined earlier in the chapter, is effective By following such a diet outline, a diet high in proteins, vitamins, and minerals will be assured The diet will be very low in fat and in starches, the carbohydrate being supplied as simple sugars or dextrinized starches, and it will be low in residue and high in anemia preventing foods Such a diet seems to control the disease and clinically restore to health the individual suffering from celiac disease or a steatorrhea

Review Questions

1 What are the principal symptoms of celiac disease?
2 What theories have been advanced as to the cause of the disease?
3 What food nutrients is the celiac unable to absorb? What ones is he able to tolerate?
4 What adjustments in diet must be made?
5 What are the principles of dietary treatment of celiac disease?
6 What food has been found to be especially efficacious in treating such patients?
7 What means may be used to furnish sufficient calories in the diet?
8 How must vitamin content be assured?
9 Is the disease of short or long duration?
10 What results may be expected if the diet is rigidly followed?

Suggested Projects

1 Plan a diet for a 3 year old child with celiac disease Calculate the nutritive content of the diet using Table 138 in the Appendix What nutrients are below those recommended by the National Research Council? Can the diet be adjusted to remedy this deficiency or must vitamin supplementation be used?
2 Plan a diet for a 6 year old child with celiac disease Include a consideration of such factors as his lunch at school, afterschool snacks and so forth What difficulties might he have in adhering to the maintenance diet in celiac? How does it compare in nutritive value with the recommendations set forth in Chapter 20?

CHAPTER 37

DISEASES OF THE LIVER AND GALL BLADDER

The liver plays such an important role in the normal functioning of the body that whenever diseases of the liver occur, serious complications ensue. In most instances, diet therapy is an important part of the over all treatment. Usually, diets high in protein and carbohydrate and moderate in fat are recommended. In addition liberal amounts of vitamins are desirable. Anorexia on the part of the patient presents difficulties in fulfilling the diet prescription.

The Liver Diseases of the liver are considered under disorders of the digestive organs inasmuch as the liver plays such an important role in the digestion and utilization of food. The liver is essential for normal protein metabolism. It stores, resynthesizes into body protein and breaks down the amino acids for combustion and deamination. It is the storehouse for carbohydrates. The liver glycogen serves as a source of dextrose to maintain the blood level constant. The role of the liver in fat metabolism is several sided. It is a storage place for fat and is concerned with the metabolism of fat soluble vitamins A and K. It is further concerned in the normal utilization of fats in that the gall bladder, attached to the liver, acts as a reservoir and stores the bile which the liver has manufactured and pours it into the intestinal tract where its work takes place. As indicated in Chapter 6, bile is necessary for normal fat absorption. The liver also acts as a detoxifying agent when toxic substances are brought into the body in food, are produced by bacterial action, or result from parasitic infections. It also converts worn out red blood cells into bile pigments. If liver cells become sluggish from continued abuse from faulty dietary regime or are injured, various abnormalities result and are followed by disturbances in digestive and metabolic functions.

The diet in liver or hepatic disease necessarily takes account of these conditions. If the liver is well stocked with carbohydrate, it is much more resistant to experimentally produced injuries, and its cells can more rapidly be restored to normal func

tion than those of a liver whose carbohydrate (and therefore glycogen) content is low. Hepatic injury brings about a lower than normal storage of carbohydrate and, hence, disposes it to further injury. See discussion of liver function in Chapter 6.

Similar to the dietary management in other conditions, the basic principles in the diet in liver disorders are (1) to allow the liver to function as normally as possible, (2) to provide adequate nutrition in order to provide for losses and replacement of injured tissue, and (3) to protect the liver against toxic agents. The dietary schedule described in the following paragraphs may be effective in both acute and chronic liver disorders.

Contrary to former views, the protein content of the diet in liver disorders should be kept relatively high rather than at merely maintenance level. Pollack and Halpern (*Therapeutic Nutrition*, NRC Bulletin No. 234) recommend a daily minimum of 100 gm., whereas others have suggested as high an intake of protein as 110 to 135 gm. The protein apparently has a protective value in addition to its function of promoting tissue repair. Moreover relatively high protein is of value in combating tendencies to change in serum proteins and hypoproteinemia which may occur in serious liver disease. Wohl* suggests that the best protein is derived from milk, cottage cheese, egg whites, polished rice, dried yeast, soybean meal, lean meats, and fish. If it is necessary to increase the protein intake, both concentrates and skimmed milk powder are helpful.

At one time fat was rigidly restricted from the diet of patients with liver disorders. However, today, a moderate fat intake is usually recommended. The range is now from 75 to 100 gm. of fat. The increase in fats has many advantages, namely, diets are easier to prepare, as many of the foods rich in protein also contain fat; the diet is more palatable, and, by including a higher fat content the caloric needs are easily met. In addition, fats are carriers of fat soluble vitamins and essential fatty acids. The emulsified fats, such as egg yolk, cream, and butter are desirable. The amount of fat used is usually the difference in calories between the sum of the protein and carbohydrate calories and the desired total calories. It must be kept in mind, however, that when the liver does not function normally, fat absorption is incomplete.

*Wohl. In Clinical Nutrition, ed. by Jolliffe. Paul B. Hoeber, Inc. p. 649.

Carbohydrate serves an important function in the dietary treatment of liver disorders. Primarily it will maintain hepatic glycogen stores and thereby exerts a sparing action on protein (see Chapter 6). Pollack and Halpern recommended 400 gm of carbohydrate per day in the diet. These may be supplied in part from sources concentrated in carbohydrate such as sugar, jelly, hard candy, and honey.

The total calories therefore may be approximately 3,000 with roughly 100 gm of protein, 100 gm of fat, and 400 gm of carbohydrate. Table 103 contains an illustrative diet which can meet this prescription.

The vitamin intake is important because of the role of the liver in the storage and utilization of vitamins, and because interference in bile secretion will decrease the absorption of the fat soluble group. The use of commercial concentrates of vitamins is therefore usually wise. Recent experimental studies indicate that vitamin C has a protective action against liver damage. High vitamin C intake at least is worth consideration.

Liver extracts are beneficial and McLester believes they should always be given a trial. It has been recommended by some that brewer's yeast, approximately 25 to 50 gm, might be given daily as it is a good source of the B vitamins and amino acids.

Anorexia is a complicating symptom and requires psychic and gustatory incentives to overcome it. Three meals a day, two between meals, and a bedtime lunch increase the potential intake with least discomfort. The diet should contain no irritating foods, condiments, or alcohol.

To summarize, the diet in liver disease should be high in carbohydrate, have a protein level of a gram to a gram and one half per kilogram of body weight, and a moderate fat level. It should have variety and should include a liberal intake of vitamins. It is designed to prevent overwork of the liver cells, to provide optimum protection against further injury, and to promote recovery. Under varying conditions the diet may be liquid, soft, or a slightly modified normal one.

Cirrhosis or hardening of the liver is only slightly amenable to diet treatment; however, if treated in the early stages nutritional therapy may prove beneficial. This disorder brings hypoproteinemia (low blood protein level) which is conducive to ascites (edema). Liberal protein should therefore, be included

in the diet The response of nutritional edema to vitamin B_1 led to its trial in the liver edema with apparent success Liver extracts are of value If only normal amounts of food are eaten with difficulty, commercial vitamins should be administered, especially vitamin K to combat the hemorrhage which frequently occurs in cirrhosis due to lack of this vitamin Lack of vitamin K may be due to failure of absorption, to a destructive action within the liver itself, or to a decrease of normally functioning liver cells Bile salts must be administered with the vitamin K unless the product is one of the new water soluble synthetic products having a vitamin K like activity Choline, cystine and methionine have been tried and found effective in the treatment of fatty and cirrhotic livers If the patient is suffering from ascites a low sodium diet may be presented The illustrative diet in Table 105 which is adjusted from the normal diet (Table 74 Chapter 27) is similar to one that might be used in cirrhosis of the liver high in protein and carbohydrate and moderate in fat

Jaundice, with greenish yellow discoloration of the skin, comes from partial or complete exclusion of bile from the intestinal tract and usually results from an inflammatory condition of the biliary tract It may also result from toxic destruction of liver cells by certain poisonings chloroform, yellow fever, phosphorus poisoning etc A third type of jaundice occurs, hemolytic jaundice from destruction of red blood cells and break down of their hemoglobin into bilirubin a bile pigment Jaundice means yellow, and in this disease the bile pigments stain both the eyeballs and the skin As indicated above, jaundice is a symptom of many possible disorders involving the liver and biliary tract

Diet in jaundice should be a simple nonstimulating, soft low fiber diet consisting chiefly of milk, cereals toast, and potatoes for the first ten days After that time tender meat, eggs, cooked fruit and simple desserts—custards gelatin rice, etc —may be added as clinical conditions permit

Infectious hepatitis is believed to be the same condition that used to be known as *catarrhal jaundice* Its etiology is not definitely known but it is thought that its cause is due to a filtrable virus During World War II the incidence of infectious hepatitis

TABLE 105

ILLUSTRATIVE DIET IN LIVER DISORDERS

Include these foods each day

Milk—1 pint to 1 quart milk or milk drinks
Meats, poultry, or fish—6 to 8 oz lean meats, fish or poultry (except those listed below)
Cheese—cottage, farmer, skim milk cheeses other cheese in moderation
Eggs—1 or 2, poached, soft or hard cooked, or scrambled in a double boiler
Bread, cereal, cereal products—4 or more servings—whole grain or enriched bread or cereal, rice, spaghetti, noodles, and macaroni
Potato—1 serving or more (except those listed below)
Vegetable, green leafy—at least one serving
Vegetable, other—one or more servings
Fruit, citrus—at least one serving, as fruit juice or fruit
Fruit, other—one or more servings, as fruit juice or fruit
Fat—limited amounts (will vary), butter, fortified margarine, vegetable oils, shortening 20% cream
Miscellaneous—tea, coffee, cereal beverages, carbonated beverages, gelatin desserts, ice cream, puddings, cakes, cookies custards in moderation, sherbets, clear candy, candy made with fruit, sugar, syrups, jams, jellies, herbs, salt, pickles, relishes, vinegar, spices in moderation, gravy (if skimmed)

Omit these foods

Meats, poultry fish—fatty meats, fish, or fowl, fried meats, fish, or fowl
Cheeses—(see above)
Eggs—fried
Bread cereal, cereal products—no restrictions
Potato—fried or potato chips
Vegetable—no restrictions
Fruit—avocado, olives
Fat—heavy cream, meat fats
Miscellaneous—desserts high in fat (pastries, some puddings), nuts, candy made with nuts, rich chocolate candy

increased Its transmission is not known, though some epidemics have been recognized as being due to water, some foods, and milk

The chief symptoms of infectious hepatitis are jaundice and enlargement of the liver Others which also occur frequently may be the clinical indications of infection, gastrointestinal disturbances, and nutritional deficiency states Capps and Barker suggest that the basis of treatment lies in bed rest and diet therapy In addition, the patient should avoid all other factors that might injure the liver further They suggest a high protein, high carbohydrate, and moderate fat diet, this might be distributed as 200 gm of protein, 300 gm of carbohydrate, and 65 gm of fat Others have suggested a diet regime similar to

the one outlined in Table 105 Although the patient may recover from the acute stage of infectious hepatitis, he usually must remain on the diet mentioned above for several months at least Many individuals, even though apparently cured of symptoms, find it necessary to be cautious in their use of fatty foods, alcohol, and condiments lest the condition recur

The **gall bladder** correlates the secretory activity of the liver with the activity of the gastrointestinal tract It stores the bile elaborated by liver cells and releases it to the intestine by hormonal or psychic stimulus Cholelithiasis (stone formation) or cholecystitis (inflammation) may interfere with the normal function of the gall bladder, and one disorder seems to bring about the other, although which is the cause and which the effect is questionable The predisposing causes are biliary stasis, with stagnation of the bile, increase in concentration, and deposition of insoluble matter Infection may involve the gall bladder and the bile

There may be disturbance in bile pigment excretion, and small pigment calcium stones are formed in certain cases of jaundice Upset of the normal cholesterol metabolism may result in the formation of gallstones, waxy and glistening, varying in size from a grain of sand to a small hen's egg, and from one to several hundred in number (94% of all gallstones contain cholesterol) Stone formation may take place at any age, but it occurs most frequently in women between 30 and 50 years, particularly in the "fair, fat, and forty" There is no evidence that there is a relationship between cholesterol in the diet and cholesterin (cholesterol) in the bile It will be remembered that endogenous synthesis of cholesterol occurs even on a low cholesterol diet *Roughly*, 2 gm of cholesterol are produced endogenously each day

The attack of gallstones or inflammation of the gall bladder is much like "indigestion" with loss of appetite, gas, sour taste in the mouth, nausea, constipation or diarrhea, sharp pain, fever and chills Intolerance for fat may be present

The dietary treatment is based on three factors association between hypercholesteremia and gallstone (biliary calculi) formation, normal stimulating action of fat upon the emptying time of the gall bladder, and the frequent coexistence of hepati

tis These conflicting factors lead to complication in diet planning and malnutrition may be a further element of confusion Diets low in fat low in cholesterol, and either high or low in calories may be used or diets relatively high in fat and cholesterol with caloric adjustment may be preferred In any case the protein is relatively high, 80 to 125 gm, since protein as well as fat has a stimulating effect on gall bladder evacuation Carbohydrate will supply the remainder of the calories which must be low enough to avoid weight gain, since obesity and overeating are undesirable When blood cholesterol is high, foods rich in cholesterol (eggs butter, cream and glandular meats) should be excluded (see table of cholesterol containing foods in Chapter 39) As Twiss and Greene point out the cholesterol values

TABLE 106

ILLUSTRATIVE DIET FOR SOME DISORDERS OF THE GALL BLADDER

Include these foods each day

Milk—1 pint or more
Meats poultry or fish—4 oz lean meats fish or poultry (except those listed below)
Cheese—cottage cheese cheddar cheese used as flavoring if tolerated
Eggs—one poached soft or hard cooked or scrambled in a double boiler
Bread cereal cereal products—4 or more servings—whole grain or enriched bread or cereal rice spaghetti noodles and macaroni
Potato—1 serving or more (except those listed below)
Vegetable green leafy—at least one serving (except those listed below)
Vegetable other—one or more servings (except those listed below)
Fruit citrus—at least one serving as fruit juice or fruit
Fruit other—at least one serving as fruit juice or fruit (except those listed below)
Fat—limited amounts (will vary)—butter fortified margarine 20% cream vegetable oils shortening
Miscellaneous—coffee tea carbonated beverages cereal beverages gelatin desserts ice cream puddings cakes cookies custard in moderation angel food cake sherbets clear candy candy made with fruit sugar syrups jams jellies herbs salts pickles relishes vinegar spices in moderation gravy (if skimmed)

Omit these foods

Meats poultry fish—bacon fatty or fried meats fish
Cheeses—all not listed above
Eggs fried
Breads cereal cereal products—no restrictions
Potato—fried or potato chips
Vegetable— gas forming vegetables such as cauliflower onions rutabagas green peppers dried peas and beans Brussels sprouts cucumbers radishes turnips broccoli
Fruit—avocado raw apples melons
Fat—heavy cream
Miscellaneous—desserts high in fat (pastries some puddings), nuts candy made with nuts rich chocolate candy

available leave much to be desired There is need for greater accuracy in distinguishing between the types of sterols present in foods However, this is the best list available at present

When the gall bladder is sluggish and neither fat intolerance hypercholesteremia, nor stones exist, a high fat cholesterol intake is of value These substances stimulate the formation of chole cystokinin, a hormone which Ivy and his co workers have shown to produce gall bladder contractions Therefore, the diet should contain a generous amount of protein and should be high or low in fat depending upon the type of gall bladder dysfunction The diet should be adjusted calorically to the nutritional need with carbohydrate The vitamin intake may need supplementa tion depending upon fat intake and absorption, and the amount of liver involvement Minerals should be adequate The diet should be nonirritating and should contain only easily digested foods The bulk should be adjusted to the condition of the rest of the intestinal tract A "lazy" colon is frequently associated with gall bladder diseases (see Constipation, Chapter 35) Smaller and more frequent meals are preferred when chole cystitis and other gastrointestinal disturbances exist Hypo acidity or hyperacidity may require consideration Frequently, a diet which is restricted in fat to approximately 40 gm is pre scribed An illustrative diet meeting that prescription and ad justed from the normal diet (Table 74 Chapter 27) is included in Table 106 The diet may be further restricted as to the kind and distribution of its fat content

Review Questions

1 What important functions does the liver perform in the digestion and utilization of food?
2 Approximately how much protein per kilogram of body weight should a diet in liver disease contain?
3 How should the carbohydrate and fat in the diet be distributed?
4 What other factors should be considered in planning a diet for a pa tient with liver disease?
5 What is the role of vitamins in diseases of the liver?
6 What is the function of the gall bladder?
7 What difficulties may interfere with its normal functioning?
8 What are the symptoms of inflammation of the gall bladder?
9 What types of diet may be helpful in treating a patient with gall blad der difficulties?

Suggested Projects

1 Plan a diet for a patient, a 19 year old man, with infectious hepatitis What are the difficulties you encountered in meeting the diet prescription? What foods can you include in the menu that may overcome his possible anorexia?

2 Plan a diet for a patient, a 45 year old woman, who has been placed on a restricted fat regime She is working and eats her lunch away from home What are the problems that she might meet in adhering to the diet? How may they be solved?

3 Adjust your own menus to the one suggested in the preceding pages for restriction of fat Which foods would you have to eliminate from your diet? Would it be difficult for you to do so? Are they foods that you particularly like or would you not object to omitting them from your menus?

CHAPTER 38

DISEASES OF THE KIDNEY

Disorders of the kidney range from acute and chronic infections to degeneration of the nephrons and metabolic disturbances of salts Most conditions require adjustments of one or more elements in the diet Chief among the modifications are protein, sodium, and fluid In some instances, it is necessary to restrict foods rich in organic salts or to choose foods that will render the urine either acid or base The extent of adjustment is governed by the disease and clinical condition of the patient

In order to understand the dietary treatment effective in diseases of the urinary tract, a summary of the kidneys and their functions is in order A brief review of kidney function is presented in Chapter 15 It will be remembered that the kidney excretes waste products in the urine, plays a major role in the regulation of the acid base balance of the body, and maintains normal composition of the blood Between 1 and 2 liters of urine are normally excreted daily The kidney is indeed one of the vital organs which, when functioning normally, maintains the body in a state of health

Nephritis

Nephritis or Bright's disease is a general term used to designate altered kidney function due either to inflammatory process or to degenerative change The classical description of the general condition was given by Richard Bright (1789 1858) in 1827 He described the dropsy, albuminous urine, and other related pathological conditions seen in this disease Since then the terms Bright's disease and nephritis have been synonymous Attempts have been made to classify or to differentiate the types by indicating the location or type of lesion, such as glomerulo nephritis, nephrosclerosis, etc The nephritic condition may be subacute, acute, or chronic and it may be complicated by edema uremia, hypertension, and gastrointestinal disturbances

Glomerular nephritis (acute hemorrhagic nephritis) is an *inflammatory* disease that affects the glomeruli It has an acute

onset with hematuria in varying degrees proteinuria edema hypertension and usually nitrogen retention It may exist in the acute latent or chronic stage McLester points out that one of the hazards of the disease is the fact that it may subside into a latent stage which results in false security since it may last for years only to flare up again The condition often follows streptococcus infection as an aftermath of tonsillitis or scarlet fever by invasion of the infecting organism into the kidneys It is essentially a disease of youth Seegal and his associates in their study found that 50% of the patients were under 10 years of age and 70% were under 20 years

The diet in the acute stage which is frequently accompanied by nausea and vomiting is usually limited to carbohydrate padded fruit juices From this the patient progresses to the milk diet and a gradual change to low sodium soft diet which at the end of ten days may gradually approximate the normal diet The Karrell diet so frequently used in acute nephritis is an entirely milk diet It consists of 800 c c of milk given as four feedings of 200 c c each It provides 550 calories 26 gm of protein 40 gm of carbohydrate 32 gm of fat 1 6 gm of sodium chloride and approximately 800 c c of water

The total fluid intake unless edema is present should be adequate to render the dissolving of the urinary solids easy If edema is present liquids must be restricted to from 800 to 1 000 c c and sodium chloride to about 3 gm or less Sodium restriction is necessary only when edema is present See Table 106 for sodium content of foods

As quickly as possible the protein intake should again reach the level of approximately 1 gm per kilogram of body weight (for the adult 10% of the desired calorie intake) in order that the body protein stores may be protected Duncan believes that most patients will have progressed to a full diet with the possible exception of the sodium content by the end of the second week

In acute nephritis then the diet is directed toward the immediate relief of the kidney caloric requirement or normal balance of food constituents being ignored inasmuch as the condition is of short duration However as soon as possible the diet should be restored to normal levels

When the condition becomes chronic, the nutrition of the patient is an important consideration Harrop believes that from the dietary standpoint, chronic nephritis is a wasting disease and that maintenance of nitrogen equilibrium is essential The dietary calculation, therefore, should be based on preferred body weight rather than on actual weight The nutritional condition of the patient is important, and, since adjustment is made necessary by the deranged kidney function, compensatory provision must be made to prevent a deficiency from occurring If obesity is not a factor, the normal caloric intake should be allowed If the caloric intake is below requirement, protein will be utilized for energy purposes unless fat stores are available This is undesirable

In years past, drastic protein restriction was practiced This led to protein deficiency which was harmful Protein must meet the normal needs and it must also replace the albumin lost in the urine—from 1 to 1 5 gm of protein per kilogram of body weight Thus, from 75 to 100 gm of protein are needed daily and some clinicians recommended 150 gm In determining the diet prescription for children, the protein should supply approximately 15% of the desired calories (see Chapter 20) at the normal level

If there is interference with the normal exchange of fluid between blood and tissue spaces, and the fluid in the tissue spaces is abnormally high, a condition known as edema (oedema) exists This may be brought about by several conditions A low serum protein level in the blood results in a nephrotic edema, when the blood protein falls below 4%, edema nearly always appears An increase in capillary wall permeability—nephritic edema—and an increase in pressure within the capillaries, caused in part by an increase in venous pressure which results from impaired heart action, produce a cardiac edema Edema may also result from failure of the body to dispose of salt normally, and from nutritional deficiencies—deficiency edema or war edema

The relationship between sodium and edema plays a role in many diseases (see Chapter 13) Drastic restriction of sodium may be extremely detrimental and excess amount may likewise be detrimental, hence the logical plan is to meet normal daily need even though theoretically very low intake may be desired If edema is present, restriction of sodium intake to maintenance

level is indicated This can be accomplished by the simple expedient of using only moderate amounts of sodium chloride in cooking adding no extra salt at the table and by omitting all salted foods These precautions will reduce salt intake to approximately 3 gm which is a minimum intake Some clinicians recommend that the patient soak meat and vegetables for approximately twenty four hours to remove sodium This can result in a highly unpalatable diet deficient in other essential minerals In addition such a diet can produce anorexia in the patient

Newburg suggests that an acid ash diet is effective in reducing edema through withdrawal of sodium from the tissues Sansum on the other hand feels that an acid ash diet renders the work of the kidneys more difficult and for this reason prefers a predominantly basic diet The general consensus is that a slightly alkaline ash is optimum (as in normal diet) except where specific alteration is needed to combat stone formation or infection (see following discussion on urolithiasis)

Anemia is frequently a complication and foods rich in iron or in substances essential to blood regeneration should be planned However it has been reported that such anemia is not improved by liver or iron therapy and that in many cases long periods of diet restriction may have been a contributing factor

Uremia appears when function impairment is so acute that accumulation of waste products takes place in the body due to renal insufficiency (inability to excrete waste products) When this occurs radical adjustment is again necessary True uremia is characterized by depression drowsiness and lethargy and finally coma Headache nausea and vomiting further complicate the condition There is retention of urine and acidosis Protein therefore must be reduced to a low level and acidosis must be combated by the use of sugar padded fruit juices High fluid intake unless circulatory disturbances counterindicate should be the rule

Nephrosis

Nephrosis is a degenerative type of Bright s disease rather than an inflammatory process in which the changes are confined to the tubules Nephrosis is insidious in its onset and usually

follows an infection or an intoxication It is characterized by profuse albuminuria, low serum proteins, edema, lowered basal metabolic rate, and anemia Hypertension and urine retention are not characteristics of this condition Nephrosis may occur as a stage in the course of some cases of chronic glomerulonephritis

The symptoms of the disease indicate the dietary treatment High protein intake, up to 2 or 3 gm per kilogram of body weight (20 to 30% of calories), i e, normal requirement plus the amount lost in the urine, increase in carbohydrate level, and sodium restriction, characterize the diet plan At times there may be a high fat and cholesterol level in the blood, lipoid nephrosis If this occurs, dietary fat must be restricted It is believed by some that lipoid nephrosis is not a true kidney disease but is due to general metabolic disturbance

Nephrosclerosis

Involvement of the circulating system, as well as reduction of renal function, results in nephrosclerosis, or arteriosclerotic Bright's disease It is a vascular disease, which in its latter stages is accompanied by impairment of the kidneys The symptoms include arterial hypertension, cardiac hypertrophy, some proteinuria, vague digestive disorders, and headache Later, as the condition advances, the heart becomes greatly enlarged, and symptoms of myocardial incompetency appear Finally, nitrogen retention and eye (retinal) changes become manifest At the end of a long course death usually results, from circulatory failure rather than from renal insufficiency The diet adjustment consists of an adequate diet of simple foods as suggested in Chapter 27 This diet is free from highly spiced and rich foods that may result in digestive upsets Salt should not be excessive, but reduction is not necessary

To summarize the dietary adjustments in the several types of renal disease, the following points must be kept in mind When nitrogen retention is excessive the protein level must be reduced When there is neither retention nor proteinuria the level should be that of the normal diet but when albuminuria is present, the protein must be increased as compensation

When edema occurs sodium intake should be reduced At other times there is no need for restriction When edema or

cardiac insufficiency is present, limitation of water is necessary If these are absent, the intake of water may be governed by thirst

TABLE 107

ILLUSTRATIVE 40 GRAM PROTEIN DIET

FOOD	AMOUNT
Milk, whole	1 cup
Meat, poultry, fish	2 oz
Bread cereal, cereal products, whole grain or enriched	4 servings
Potato cooked	1 small
Vegetable, green, leafy	1 serving
Vegetable other	2 servings
Fruit, citrus	1 serving
Fruit, other	2 servings
Butter or fortified margarine oils	As desired

Adapted from Basic Diet (Table 74) This diet plan is lower than the Recommended Allowances for a 25 year old woman in protein calcium iron thiamine riboflavin and niacin

In the presence of high blood fat and blood cholesterol, the fat intake should be limited to a low level Otherwise the diet should be adequate as to calories except in acute stages or where weight loss is desired The diet should have a somewhat higher than usual level of carbohydrate It should meet the normal need for vitamins be free of high spicing or condiments or any constituent which may be irritating The diet should be adjusted (unless contraindicated) to leave a neutral or slightly alkaline ash A diet high in protein may be found in Chapter 27 The details of a diet restricted in sodium are given in Chapter 39 An illustrative diet which is low in protein is included in Table 107

Urinary Tract Infections

Pyelitis, inflammation of the pelvis of the kidney, or pyelonephrosis and cystitis, inflammation of the bladder, are all infections of the urinary tract Treatment is directed toward the elimination of the infecting organisms Forcing fluids and alteration in urinary pH are of value These may be brought about by adjustment in acid base balance and by the use of the ketogenic diet, which is also acid ash This diet, as pointed out under Epilepsy, Chapter 32, is difficult to follow

Recently the sulfa drugs, sulfanilamide, sulfapyridine, etc, and mandelic acid have largely superseded dietary adjustment, although there is greater effectiveness when dietary adjustment

is also made. This is especially true when mandelic acid is administered. The object is to increase the acidity of the urine to the point that infecting organisms cannot grow. An acidity of approximately pH 5.2 (5.5 to 5.0) seems effective.

Supersaturation of Urine

Under the influence of the colloids of the urine, greater concentration of salts is possible than in a simple water solution. When there is interference with this physiochemical equilibrium precipitation of salts can occur, but this is not a disease condition. It is a metabolic disturbance. A number of salts may be so affected.

Phosphaturia occurs when phosphate crystals are thrown out of solution. This results in a milky, cloudy urine and frequently occurs in nervous tension or nervous upsets. Treatment consists in quieting the nerves, the ingestion of an acid ash diet to favor phosphate solution and a diet low in calcium, which also tends to increase the solubility of the phosphorus. The diet naturally should be low in phosphorus. Calcium poor foods, such as meat and cereals, should replace milk, eggs, and green vegetables so far as possible, without interfering with adequate nutrition.

Oxaluria indicates that calcium oxalate crystals are being precipitated. This may take place in either an acid or an alkaline urine. Foods rich in oxalates spinach, beans, tomatoes, figs, strawberries, potatoes, plums, cocoa, chocolate, and tea should be avoided. Bread, muscle and glandular meats contain some oxalate and should, therefore, be eaten in moderation. Foods containing little or no oxalic acid, such as dairy products, fats, rice, peas, cabbage, asparagus, mushrooms, apricots, grapes, and melons, should form the greater part of the diet (see Appendix for oxalic acid content of foods).

Urates, when deposited, result in a condition known as uraturia. The precipitation takes place in acid urine. The rendering of the urine alkaline and a decrease in uric acid (purine) intake are effective in controlling the condition. The elimination of uric acid requires omission of all glandular meats, whole grain cereals, certain vegetables, etc. (see Gout).

Cystinuria, as the name implies, is a deposition of cystine. Under ordinary circumstances, cystine is destroyed and appears

only in minute traces in the urine In such conditions the urine should be rendered alkaline and sulfur rich foods should be curtailed Milk should be the chief source of protein since it is high in biological value and low in sulfur Eggs may be used in moderation Meats should not be used at all Occasionally the metabolic disturbance may be such that other amino acids may also appear in the urine

Alkaptonuria is a disease in which the intermediary metabolism of protein in the liver is disturbed The urine becomes dark upon standing due to the presence of homogentisic acid which is derived from the amino acids tyrosine and phenylalanine Therefore these acids must be restricted Proteins in general should be reduced to maintenance level Milk cheese and cream are important sources of tyrosine and should therefore be restricted

Renal Calculi (Urolithiasis)

When excessive precipitation of urates oxalates or phosphates occurs stones may be formed in the kidney These are usually combinations of all three salts but with one salt predominating Infection and deficiency of vitamin A are probably causative Symptoms of vitamin A deficiency can usually be shown to coexist with stone formation The dietary treatment will depend on the type of stone and the associated symptoms Dietary changes suggested for oxaluria phosphaturia etc are applicable to stones as well The pH adjustment may be dietary and chemotherapeutic High vitamin A intake is important here as in all infections of the urinary tract Dietary history frequently will show that fat restriction has existed which means that vitamin A inadequacy has permitted changes in the epithelial tissue lining the urinary tract Inadequacy of vitamins C and B also predispose to infection Too high carbohydrate intake and prolonged use of mineral water endocrine disturbance and kidney malformation are all contributory causes of this condition

Cystinuria and alkaptonuria are somewhat hereditary in occurrence This is not true of other types of stones While stones may occur at any age about 50% appear between 30 and 50 years of age and slightly more often in the male There may be countless small stones the size of a pin point, or large stones even as large as an orange

TABLE 108

EXCESS OF ACID FORMING OR BASE FORMING ELEMENTS

ARTICLE OF FOOD	EXCESS ACID OR BASE IN TERMS OF NORMAL SOLUTIONS			
	PER 100 GRAMS		PER 100 CALORIES	
	ACID (C C)	BASE (C C)	ACID (C C)	BASE (C C)
Almonds		12 38		1 86
Almonds		11 76		1 76
*Apples		3 76		5 98
Asparagus		0 81		3 65
Bananas		5 56		5 62
Beans, dried		23 87		6 92
Beans, dried		11 58		3 36
Beans, Lima, dried		41 65		12 08
Beets		10 86		23 57
Cabbage		4 34		13 76
Cabbage		7 10		22 51
Carrots		10 82		23 91
Cauliflower		5 33		17 48
Celery		7 78		12 17
Cherry juice		4 40		
Chestnuts		7 42		3 19
Corn, sweet, dried	5 95		1 77	
Crackers	7 81		1 95	
Currants, dried		5 97		1 85
Eel	9 89			
Eggs	11 10		7 55	
Egg white	5 24		9 52	
Egg yolk	26 69		7 08	
Fish, haddock	16 07			
Fish, pike	11 81			
Lemons		5 45		12 32
Lettuce		7 37		38 69
Meat, beef, lean I	13 91		12 10	
beef, lean II	10 05		8 74	
beef, lean	12 00		10 44	
beef, lean	13 67		11 89	
chicken	17 01			
frog	10 36			
pork, lean	11 87			
rabbit	14 80			
veal	13 52			
venison	15 83			
Milk, cow's		2 37		3 44
Milk, cow's		1 26		1 83
*Muskmelon		7 47		18 82
Oatmeal	12 93		3 23	
Oatmeal	10 63		2 66	
*Oranges		5 61		10 94
Peaches		5 04		12 20
Peanuts	3 9		0 70	
Peas, dried		7 07		1 98
Peas, dried		3 36		0 94
*Potatoes I		7 19		8 63
*Potatoes II		5 5		

TABLE 108—CONT'D

ARTICLE OF FOOD	EXCESS ACID OR BASE IN TERMS OF NORMAL SOLUTIONS			
	PER 100 GRAMS		PER 100 CALORIES	
	ACID (C C)	BASE (C C)	ACID (C C)	BASE (C C)
Potatoes		7.7[illegible]		9.[illegible]6
Prunes		24.40		8.05
Prunes		25.55		8.43
Radishes		2.87		9.79
*Raisins		23.68		6.87
Raspberry juice		4.91		
Rice I	8.1		3.35	
Rice II	7.08		2.05	
Rice	8.35		2.42	
Turnips		2.68		6.86
Turnips		6.80		9.41
Wheat, entire	9.66		3.25	
Wheat, entire	12.39		3.47	
Wheat, flour	11.61		2.70	

*Have been found experimentally by Blatherwick to be particularly effective in reducing the acidity of the urine

Reproduced from Sherman and Gettler J Biol Chem 11 323 1912 Courtesy of Dr Sherman and the Journal Dr Sherman in granting permission writes In using these figures it should be quite clear that they are arrived at by calculations from the analyses which calculations involve assumptions so that the figures should be taken only as general guides These figures are however of value in adjusting urinary pH by means of diet

The presence of a stone brings on vague discomfort in the region just under the ribs in the back and about 2 inches from the spinal column This is accompanied by tenderness and a disinclination to move Sudden sharp knifelike pains, radiating down around the lower part of the abdomen may occur Urine is scanty, but the desire to urinate is frequent Blood may be present in the urine as the result of trauma to the ureter from the stone When the stone has passed into the bladder, the pain ceases Inasmuch as the stones may form at intervals all possible dietary adjustment should be made and continued as preventive measures While dietary adjustment does not always bring about the desired results a liberal water intake, elimination of possible causative food factors increased intake of vitamins A, B, and C elimination of foci of infection, and avoidance of infections, in addition to observance of the general rules for good health and hygiene should be included as part of the treatment

The benefit derived from either an alkaline ash or an acid ash diet in renal calculi is a subject of controversy Table 108 lists foods which contain excess acid forming and base forming ele

TABLE 109

FOODS INCLUDED AND EXCLUDED IN HIGH ACID ASH DIET FOR BASIC URINARY CALCULI

TYPE OF FOOD	FOODS INCLUDED	FOODS EXCLUDED
Beverage	Cereal beverage, coffee, milk not more than 1 pint daily, tea	Carbonated beverage
Bread	Any, with emphasis on whole grain or enriched bread, except those listed under "Foods Excluded," at least 6 slices daily, crackers, rolls	Boston brown bread, pumpernickel, Rusk
Cereal	Any, with emphasis on whole grain or enriched, at least 1 serving daily	None
Dessert	Cakes and cookies, except those listed under "Foods Excluded," cream or custard pie, cranberry, plum or prune desserts, custards, plain ice cream, plain cereal puddings	Cornstarch pudding, desserts made with fruit other than cranberries, plums or prunes, gelatin desserts, gingerbread, molasses cookies
Fat	Butter, cream, not more than ½ cup daily fortified margarine, salted dressing, salad oil, shortening	None in amounts allowed
Fruit	Cranberries, plums, prunes, not more than 1 serving daily of other allowed fruits	Dried fruits except prunes, bananas, rhubarb
Meat, egg or cheese	Any meat, fish or fowl, including 1 egg and at least 2 servings of meat or substitute daily, any cheese except those listed under "Foods Excluded"	Gruyere cheese, Parmesan cheese
Potato or substitute	Corn, hominy, lentils, macaroni, noodles, rice, spaghetti, 2 servings daily	Potato
Soup	From foods allowed, broth	Soup from dried beans or peas
Sweets	Cranberry or plum jelly, sugar, peanut brittle, plain sugar candy	Other candy, honey, other jam, jelly or marmalade, molasses, syrups
Vegetable	2 servings daily as allowed	Dried beans, beet greens, dandelion greens carrots, chard, endive, kale, kohlrabi, Lima beans, spinach
Miscellaneous	Brazil nuts, filberts, gravy, peanut butter peanuts, popcorn, salt, spices walnuts	Other nuts, olives, pickles, vinegar, white sauce

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TABLE 110

FOODS INCLUDED AND EXCLUDED IN HIGH ALKALI ASH DIET FOR ACID URINARY CALCULI

TYPE OF FOOD	FOODS INCLUDED	FOODS EXCLUDED
Beverage	Carbonated beverages, cereal beverage, coffee, milk, at least 1 pint daily, tea	None
Bread	Any, with emphasis on whole grain or enriched, not more than 3 slices daily, crackers if substituted for bread, rolls	None in amount allowed
Cereal	Any, with emphasis on whole grain *or enriched not more than* ½ *cup* daily	None in amount allowed
Dessert	Cakes and cookies containing permitted fruit or nuts cornstarch pudding desserts made from permitted fruits gelatin desserts, plain ice cream milk desserts	Plain cakes and cookies, plain cereal puddings, cranberry, plum, or prune desserts, custards
Fat	Butter cream fortified margarine salad dressing salad oil, shortening	None
Fruit	1 citrus fruit or juice and at least 3 servings of other fruit daily with emphasis on dried fruits except prunes	Cranberries, plums, prunes
Meat egg or cheese	Any meat fish fowl or cheese but not more than 1 egg and 4 ounces of meat or substitute daily	None in amounts allowed
Potato or substitute	Potato at least once daily	Hominy macaroni, noodles rice, spaghetti
Soup	Any except those containing barley flour noodles rice or spaghetti	Thickened cream soups soups with barley noodles, rice or spaghetti
Sweets	Candy honey jam, jelly and marmalade except those listed under "Foods Excluded" molasses sugar syrups	Cranberry or plum jelly
Vegetable	At least 4 servings daily	Corn lentils
Miscellaneous	Almonds, chestnuts cocoanut olives pickles salt spices, vinegar	Flour gravy, all nuts except those listed in "Foods Included", peanuts, popcorn white sauce

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ments In some cases daily menus are calculated for the patient from tables such as these Others prepare diets which will produce either excess acid or base in the urine, and from these diets the daily menus are planned Tables 109 and 110 illustrate such diets

Review Questions

1 What diet is often prescribed for a patient with acute nephritis? What constitutes the diet and what are the underlying principles?
2 If the diet is not well tolerated, how else may nourishment be given?
3 What should be the fluid and sodium intake in the diet for acute nephritis?
4 What are the factors that govern the protein intake in chronic nephritis? Explain
5 What is the importance of calories in chronic nephritis?
6 What dietary measures must be instituted if uremia appears?
7 What is the diet plan in nephrosis? Nephrosclerosis?
8 What dietary adjustments may be effective in causes of pyelitis and cystitis?
9 Precipitation of various salts in the urine may occur What food restrictions should be made in the following phosphaturia? oxaluria? uraturia? cystinuria? alkaptonuria?
10 If there is excessive precipitation and kidney stones are formed, what are the dietary indications?
11 What role does vitamin A play in these conditions? Vitamins C and B?

Suggested Projects

1 Plan a day's menu for a 12 year old boy with chronic nephritis Did you have any difficulty in planning foods that would be appetizing to him? Does your menu meet the nutritional needs of a boy that age?
2 Plan a day's menu for a 10 year old girl with nephrosis What are the foods that children particularly enjoy that you had to omit from this diet? What foods were you able to include that are appealing to children? Do you think that a child suffering from anorexia would consume a diet similar to the one you planned? What can you do to encourage her to eat?
3 Plan a day's menu which meets the nutritional needs of a 45 year old man who has been placed on an acid ash diet for renal calculi It is necessary for him to eat his lunch at a lunch counter What difficulties would he encounter in following his diet while he is away from home? What adjustments could he make so that he will be able to go out socially once or twice a week?

CHAPTER 39

CIRCULATORY DISTURBANCES

Cardiovascular diseases are responsible for 600 000 deaths per year in the United States. Dietary modification is used extensively in the treatment of the different disorders. Reduction in body weight may be the initial consideration. As the causes for the various heart conditions are unknown, the diet is planned to bring about a symptomatic relief. The diet may be modified in caloric, fat, cholesterol, and sodium content, as well as limited to specific foods, depending on the particular disorder and the condition of the patient.

Diseases of the kidney and diseases of the circulatory system are so intimately connected that one cannot be discussed without reference to the other. Malfunction of either soon results in complication within the other. The role of the heart needs little comment. It is the pump that sends the blood throughout the body on its mission of food supply and waste collection. The heart may not function normally; there may be changes in the arteries or veins. The kidney may not effectively remove the products intended for urinary excretion. The interrelationship is obvious, and complications in any one condition frequently result from association of other factors.

The force with which the heart contracts as it expels blood may be measured. A measurement of blood pressure is a common procedure. With the sphygmomanometer (the blood pressure cuff is an example) it is possible to determine the amount of pressure needed to block the passage of blood through an artery. This systolic pressure represents the tension to which the blood vessels are subjected under the full force of the heartbeat as the heart contracts. As the pressure is released and the blood again flows through, a second pressure level is determined, the diastolic pressure or minimum strain put upon the arteries. This is the decrease in force of pressure as the heart dilates or its period of greatest relaxation. Any abnormality in the heart or in any of the blood-carrying vessels will be reflected in these pressure values. While systolic blood pressure varies with age, sex, gen-

eral health, heredity, characteristics, time of day, eating habits, climatic conditions, state of mind, etc., certain average values can be assumed. Woley's values for systolic pressure are given below.

Age	*Average Systolic Pressure*
15 30	122
31 40	127
41 50	130
51 60	132

The heart itself may suffer functionally or organically, and various parts may be affected: the pericardium or outer covering, the myocardium or heart muscles, or the endocardium or membranes lining the heart.

In many instances it is desirable to reduce the work of the heart. If the patient is obese, reduction in body weight should receive first consideration in relieving cardiac strain. McLester outlines the disadvantages of obesity as fourfold. First, a lack of balance between the body mass and the heart strength, an undesirable condition even when the integrity of the heart is unimpaired. Second, the heart may be the seat of abnormal fat deposits on the surface and between the muscle bundles. This condition naturally decreases muscular efficiency. Third, accumulations of fat in the abdomen may limit free movement of the heart. Fourth, atherosclerosis, which frequently accompanies obesity, may involve the coronary artery which supplies the blood to the heart muscles. Obviously a reduction in the weight of the obese person is desirable, especially if he suffers from some form of cardiac impairment.

In the patient with congestive heart failure the elevated basal metabolic rate must be lowered. A reduction of the total caloric intake is frequently the initial therapy. In some instances the Karrell Diet (see Chapter 38) is recommended for the first 24 or 48 hours. The diet may then be modified with the addition of such foods as cereal, fruit juices, soft cooked eggs, toasted white bread, puréed vegetables, gelatins, custard and pudding. Others suggest using approximately a 400 calorie diet initially, and still others recommend an 800 calorie diet. Of course, the vitamin and mineral content of such regimens should merit consideration. Beneficial results have been reported by using a 1,200 calorie diet.

Undernutrition brought about by a subcaloric diet has been thought responsible for such improvement in the patient with congestive heart failure as a drop in both systolic and diastolic blood pressure, a decrease in the size of the heart, and an increase in the blood flow. By lessening the burden of the heart its efficiency is improved. McLester and Darby point out that even the cardiac patient who is not obese may benefit from an undernutrition regimen.

The reduction diet should be planned to be entirely adequate to maintain good nutrition while a slow, steady weight loss is brought about. Glucose has beneficial effect on the myocardium and a high carbohydrate diet is therefore indicated. Liberal vitamin B_1 is recommended, or better, the use of the entire complex, inasmuch as it has been beneficial in the cardiac changes accompanying pellagra, and experimental data indicate the importance of the synergistic (working together) action of the vitamins of the B group. There is also evidence that vitamin C has something to do with myocardial health. Protein must be adequate in order to spare tissue protein. Low serum protein is not uncommon in the latter stages of cardiac dysfunction. Dynamic action is not desired and, therefore, adequate but not excessive protein is indicated. The diet must be planned to prevent digestive upset and flatulence; therefore, readily digested foods are given. Curtailment of fat is advised in the interests of rapid gastric evacuation. Small, frequent feedings may be desirable rather than the customary three meal schedule.

It may be necessary to institute measures designed for the prevention or elimination of edema. Wohl indicates that a diet low in sodium and acid ash without the restriction of fluid intake (which was previously prescribed) is effective in treating edema. Foods low in sodium are discussed in the following paragraphs under hypertension.

Atherosclerosis

The exact cause of atherosclerosis is not known. Heredity and constitutional predisposition would seem to play a part, but, in any event, the circulation is impaired. McLester and Darby suggest that it has its inception in childhood and that after adolescence it is present in some degree in almost everyone. Confusion often exists between arteriosclerosis and atherosclerosis. Ar

teriosclerosis is a pathological condition which is characterized by changes in the blood vessel walls such as excessive growth of connective tissue in the muscular layers or the abnormal deposition of extraneous material within the inner layers of the arterial wall These changes which are believed not to be a part of the normal aging process result in narrow rigid blood vessels This condition is often referred to as hardening of the arteries

Atherosclerosis on the other hand usually refers to that condition in which cholesterol in combination with fatty acids and protein are deposited in the inner layers of the blood vessels In contrast to arteriosclerosis and atherosclerosis normal aging is characterized by a loss of muscle tone and dilation of the blood vessels

Recent research has focused attention upon atherosclerosis Studies have been directed toward gaining an understanding of the primary cause for the depositions described Atherosclerosis has been produced experimentally in animals notably rabbits and dogs by repeated large doses of cholesterol However many have indicated that it is treacherous reasoning to extend such findings in experimental herbivorous animals to omnivorous human beings

Some research indicates that there may be a relationship between hypercholesterolemia and atherosclerosis As Gofman points out the nutritional problem is to determine what role nutrition plays in the control of serum lipid levels regardless of how the serum lipids are described

There have been two major approaches recently in the dietary treatment of atherosclerosis One approach has been directed toward the reduction of the overweight patient who has atherosclerosis In some cases it was noted that these patients had high levels of serum lipids Some of these patients benefited from the correction of overweight that is the level of serum lipids was reduced However in many patients who were overweight with elevated serum lipids the serum lipids were not reduced when the patients lost weight Many overweight individuals do not have a high level of serum lipids and many normal or underweight individuals are found to have a similar high serum lipid level Thus while overweight may be considered a contributing factor to elevated serum lipids it cannot be designated as a cause and effect relationship in atherosclerosis

A second dietary approach in the treatment of atherosclerosis has been the restriction of fats specifically cholesterol This restriction has been based in part upon the animal experimentation cited in which large dosages of cholesterol have been induced and a condition resembling atherosclerosis has resulted and upon the observation of some patients with elevated serum lipids which are reduced when the intake of fat is lowered The restriction of fat and dietary cholesterol in atherosclerosis is one of the most controversial areas in diet therapy today It is recognized that cholesterol is not a dietary essential as it may be synthesized by the body Cholesterol is a normal constituent of the blood One of the primary objections to the dietary restriction of cholesterol is that it is found in so many nutritionally valuable foods eggs milk meats It has been reported that a diet without any fats at all both vegetable and animal will reduce cholesterol in the blood

TABLE 111

CHOLESTEROL CONTENT OF FOODS*
Mg per 100 Gm fresh material

	MG %
Bacon	38 78
Beef	38 78
Brain	2 130 3 700
Chicken	59 527
Kidney	200 3 400
Liver	130 3 400
Pancreas	3 120
Pork	46 48
Veal	84 88
Fish	21 95
Oyster	215
Salmon roe	2 [illegible]00
Bacon fat	108
Butter	185 340
Cod liver oil	400
Fats—lard suet	100 350
Milk cow's whole	12
Milk cow's skim	2
Cheese	42 88
Egg whole	240 490
Egg yolk	1 180 [illegible] 150

*Data on cholesterol content of foods lack uniformity Values here are compiled from data by T[illegible]iss and Greene J A M A 101: 1841 1933 and summary from Cook Nutrition Abstr & Rev 1[illegible] 1 194[illegible] Cholesterol is an animal product it does not occur in plants or in lipids derived from plants See also Okey Ruth Cholesterol Content of Foods J Am Dietet A [illegible]1 341 1945 and Mann George V Dietary Aspects of Cholesterol Metabolism and Disease J Am Dietet A 25 389 1949

Many clinicians believe that there is no conclusive evidence to date that the ingestion of moderate amounts of foods containing fats and cholesterol is significant in relation to the cause of atherosclerosis or to the progress of the condition in the patient. It has been suggested that perhaps this restriction might take the form of the elimination of the foods especially rich in cholesterol (see Table 111) and only mild restriction in the use of the commonly used foods, such as eggs and whole milk. The cholesterol content of many foods is included in Table 111. It has been reported that the average food intake may contain approximately 1,600 mg of cholesterol. Many low cholesterol diets may range from 100 to 300 mg.

In summary, there is no general agreement in the dietary treatment of atherosclerosis. This may be due to the fact that the relationship between the food intake and the cholesterol content of the blood has not been established. In addition, the significance of the elevated serum lipids as a primary cause of atherosclerosis is not universally accepted. It has been suggested that the answer may lie in a mechanism which regulates cholesterol metabolism which, in atherosclerosis, is disturbed so that abnormal deposits occur. Diets restricted in fat or cholesterol content may or may not be prescribed. The extent to which the cholesterol content of ingested foods is restricted will vary. In many cases the overweight patient is placed on a low calorie diet which is believed beneficial in reducing the level of serum lipids. In other instances, restoration to normal weight is advised on the basis of the benefit in all cardiac complications and the relationship to the general health and well-being of the individual (see Chapter 22).

Hypertension

Hypertension is not a disease per se but rather a symptom which may result from many causes. Both the underlying cause and the hypertension require treatment. Ninety per cent of all patients with hypertension belong to a group known medically as essential hypertension. This refers to a condition of chronic hypertension of unknown cause or causes. The causes for hypertension may be organic or functional. By organic is meant a structural change in the heart, blood vessels, kidneys, or other organs—a change which will persist. Functional change may

be due to an emotional upset or a transitory cause of some kind Infection and obesity are frequent factors

Hypertension is a condition in which persistent elevation of blood pressure above average occurs A persistent systolic pressure over 150 is usually regarded as significant Heart and renal involvement are logical sequences Diet therapy is intended to relieve the strain on the vessels involved That mild undernutrition is desirable to attain this end is generally accepted How this condition should be brought about and how extensive it should be has been a matter of conflicting ideas

While the basic causes for hypertension are as yet unknown there are many factors which have been described by Wakerlin as contributory Among these are heredity, the condition seems to appear more frequently in some families than others aging the majority of patients are in the 40 to 69 age group body build hypertension is found frequently in the short stocky sthenic type rather than in the tall lean asthenic type mode of living so called high tension living has been thought by many to predispose hypertension high protein diets especially diets containing large amounts of red meats and high fat diets have been accused as contributing factors to hypertensive conditions Experimentally there is little evidence that these diets are conducive to high blood pressure popular opinion to the contrary Wakerlin also points out that there is increasing evidence that nervous endocrine and renal factors play roles perhaps of varying importance in different patients in essential hypertension

There is wide variety in the diets suggested for the patient with essential hypertension Some suggest a diet as well as a life of which the key word might be identified as moderation Others find that the so called rice diet of Kempner is beneficial Still others will restrict the sodium content of the ingested food to a varying degree In some cases the restriction may be described as mild and in others it may be severe Again diets that are helpful in reducing hypertension in one patient may not be effective in another In all cases individual prescription is governed by the condition of the patient

In the first dietary adjustment mentioned moderate amounts of sodium and water are allowed The major alteration is in caloric intake—an adjusted level adequate to produce and maintain the desired weight The diet apart from caloric re

striction, is the same as that recommended in health but with each item more strictly *held in moderation* In fact, moderation was the key to treatment Moderation in eating, drinking, smoking, physical and mental effort, and emotional stress, the mental emotional side perhaps having greater emphasis than the dietary Certainly, there is no clinical condition in which peace of mind, tolerance, cheerfulness, relaxation, rest, and moderate exercise can play a more important part The condition of the patient will determine the degree of moderation and whether this type of diet is beneficial

In the past several years there has been widespread interest in the "rice diet" Kempner introduced the diet in 1940 at the Duke University School of Medicine In 1944 he published reports which described the results of treatment by means of the rice diet of some 150 patients during the previous four years Table 112 contains the diet as described by Kempner Patients have remained on the diet from four days to thirty months Kempner, in 1944, reported a marked drop of blood pressure reduction in the size of enlarged hearts (to normal size in most cases), reduction of edema, and improvement in electrocardiogram readings In 1954 ten years after his first published reports, Dr Kempner has extended his observations to more than 2,000 patients treated with the rice diet He is convinced that its use is extremely beneficial in the treatment of hypertension He suggests further that the diet should be instituted when the patient can be under clinical observation

The diet contains approximately 2,000 calories per day, as 5 gm of fat, 20 gm of protein, and 450 gm of carbohydrate It contains not more than 0 15 gm of sodium and 0 2 gm of chloride One of the chief objections to the extended use of the rice diet has been its low protein content Some experiments have indicated that the patient, while seemingly needing less protein than is normally accepted, does not remain in nitrogen equilibrium Kempner reported that his patients were in nitrogen equilibrium It has been suggested that the benefits derived from the rice diet came not from any efficacious effect of rice but probably from the fact that this regimen is essentially severely restricted in sodium

As one would expect this is a diet of extreme monotony as well as one lacking in palatability Special care must be used in its

preparation However, Page and Corcoran pointed out that "when prescribed with authority and enthusiasm, when undertaken in the team spirit of the rice houses (all patients on the rice diet eat together at special dining rooms), and when followed by the faintly masochistic, the rice diet admittedly yields some startling clinical results" As Kempner indicated, the diet is monotonous, it has to be eaten quite a while before its full effect becomes apparent, the patients should be in the hospital until

TABLE 112

KEMPNER RICE DIET

Pro—20 gm, Fat—5 gm, Cho—450 gm, Cal—2,000, Na—0 15 gm; Cl—0 2 gm

Include each day

Rice

250 350 gm (dry weight) of rice, white or brown

Fruits

uncooked any fruit with the exception of avocado pears, dates, and nuts

cooked any as above

canned any as above—there must be no preservative added (benzoate of soda, sulfur dioxide, no artificial color or flavor, no corn syrup)

dried not permitted

frozen any as above

jellies and preserves these must contain no added pectin and no preservative and therefore homemade jellies and preserves are preferable

Sugar may be added as desired, brown or white Glucose or dextrose may also be used (they are less sweet and better tolerated by some people) Honey is also permitted but not maple sugar

Fruit juices any fresh or cooked fruit juice may be used which contains no preservative artificial flavor or color Tomato juice is not permitted The *total fluid intake* should consist of fruit juices and the amount is limited to 700 to 1 000 c c a day except where variations are advised by the physician for some special condition No additional fluids of any kind are permitted and this includes water

Food forbidden

Any foods not listed above

Salt in any form

Fat in any form (this eliminates cream, butter, etc)

Milk

Nuts, dates, and avocados

Preservative, pectin, artificial coloring, etc

Supplementations of vitamins and minerals

Vitamin A	5,000 I U
Vitamin D	1,000 I U
Thiamine	5 mg
Riboflavin	5 mg
Niacinamide	25 mg
Calcium pantothenate	2 mg
Iron (ferrous sulfate)	0 6 gm

they are "regulated" on the diet and constant checks on their blood and urine chemistry should be made, and the diet becomes worthless if it is modified by so called "small" or "minimal" additions according to the patient's own taste

The rice diet has been modified in various ways Kempner suggested that after a suitable period small amounts of other foods such as nonleguminous vegetables, an egg and 4 ounces of lean meat could be added each week King proposed that the restricted diet might be followed for a specific critical period and then modify it with essential nutritional supplements and when necessary return to the original diet for limited periods as a temporary therapeutic expedient

Another suggested modification* might be that an egg a week and a nonleguminous vegetable and a cup of tea or coffee be added to the diet At the end of a month 4 ounces of meat fish or liver is included three times weekly, with two slices of salt free bread A month later this is increased to a serving of meat daily a second nonleguminous vegetable, and an egg three times weekly At the end of this month, if progress has continued to be satisfactory egg and potato are allowed daily

Opinions as to the general acceptance of the rice diet vary It is extremely difficult for the patient to follow, yet if he believes that it is imperative to his health, he can adjust to it It has been successful in that a large number of patients reduced the blood pressure

Recently the low or restricted sodium diet has been used with increasing frequency Gratifying results are reported, although opinion differs as to the extent of restriction necessary Just why reduction should relieve hypertension is not clear Again strict dietary treatment perhaps is justified in spite of insufficient information as to its specific action

French physicians Ambard and Beaujard suggested a restriction of sodium chloride in the treatment of hypertension at the turn of the century Allen and Sherril in 1920 were the first to adopt this treatment in America It is recognized today that it is the sodium ion which must be restricted rather than sodium chloride (salt) Some students confuse the relationship between sodium and salt Salt is composed of two elements sodium and

*New England J Med 239 531 1948

chloride. Each molecule of salt is 40% sodium. We obtain sodium from many other sources besides salt. Baking powder, baking soda, sodium benzoate, some public water, and some foods are high in sodium, to name a few. It has been estimated that the average person consumes from 3 to 5 gm. of sodium daily, which is from 7 to 14 gm. of salt.

The extent to which sodium is restricted in the diet must be determined for each patient. Many clinicians have found that severe restriction is necessary for good results. Grollman indicates that he finds excellent response at times when the restriction is held down to 0.5 gm. (500 mg.) daily. "Moderate restriction of sodium fails to influence the blood pressure." Results vary with the nature of the underlying disorder and the duration of the disease. To his mind, the results of this treatment seem to justify the diet restriction. However, he concedes the dangers of deficiency and suggests close watching of such patients.

The American Heart Association in their pamphlet *"Food for Your Heart,"* prepared by the Department of Nutrition, Harvard School of Public Health, has set forth three levels of sodium restriction: mild, moderate, and severe. These levels of restriction are compared with the normal daily consumption in the following table:

	Sodium	*Salt*	*Teaspoons of Salt*
Normal consumption	3 to 5 gm.	7 to 14 gm.	1 to 2
1. Mild restriction	1.5 to 3 gm.	3.7 to 7 gm.	½ to 1
2. Moderate restriction	0.5 to 1.5 gm.	1.2 to 3.7 gm.	⅙ to ½
3. Severe restriction	Less than 0.5 gm.	Less than 1 gm.	Less than ⅙

By following the mild restriction of sodium in Table 113, a 50% cut in sodium consumption may be effected; by moderate restriction, a 75% or more may be eliminated; and in severe restriction as described in Table 113, 90% or more sodium may be cut from that found in the normal diet. Unless weight loss is desired, the calories do not necessarily have to be low. The diets in Table 113 may easily be reduced in calories. There may be many foods in these diets which may be undesirable for other reasons. For example, some patients may not be able to tolerate certain gas forming vegetables, so some of the vegetables allowed on the low sodium diets would be eliminated.

So far as possible, the low sodium diets should be modified from the family menu Salt can be added by the other members of the family at the table or, after the dieter's portion has been served, the remaining food can be seasoned Occasionally, of course the individual on a low sodium diet will have to have foods different from the other family members However, the diet need not be a "special" one

Milk is quite high in sodium (50 mg per 100 c c), and, for that reason, it is limited to 1 pint on the mild and moderately restricted diets It must be omitted on the diets severely restricted in sodium However, if this is done, the diet will be low in calcium and possibly other important nutrients Low sodium milks are available in powdered form To many patients they are expensive and unpalatable Irwin and Schuck report that they found the greatest acceptability when the dialyzed milk (low sodium) was used in the form of milk soups Cheese also contains large amounts of sodium especially cheese containing whey Sodium, being water soluble is found mostly in the whey fraction Cottage cheese may be made salt free if it is placed in a plastic bag and then thoroughly washed by running cold water for at least one hour In many communities low sodium cottage cheese is available in the markets

Fruits may be used in any form in the low sodium diet However, care must be taken that jams or jellies do not contain sodium benzoate Many dried fruits are processed with sodium acid sulfite prior to drying

Vegetables are usually allowed in the fresh and frozen state Sodium chloride is used in the flotation process in sorting green peas and Lima beans from hardened peas and heavy extraneous matter and sodium chloride is also used as a blanching agent in freezing foods If there is no information on the label indicating that sodium has been used in commercial processes, it is advisable to check with the manufacturer before using products which might contain undetected sodium Most commercially canned vegetables and vegetable juices have added salt However, vegetables canned without salt are available

Fresh meat, fish, and poultry have a fairly high content of sodium and, therefore, the amounts of these foods are limited These foods are included in the diet for the necessary nutrients

they provide namely, protein the B complex and iron even though they may supply sodium as well Most canned meats fish and poultry are salted however increasing amounts of these foods are canned without salt

Unsalted or 'sweet' *butter* is available to most individuals As a change both vegetable oils and lard contain negligible amounts of sodium and may be used as fat as well as butter

Salt has been added to many of the ready to eat *cereals* Some however are free of sodium Among those that may be used on the low sodium diet are puffed wheat shredded wheat macaroni spaghetti puffed rice and regular oatmeal Cream of Wheat and Farina The label may or may not tell if sodium has been used in processing but commercial concerns are willing to provide such information upon request

Apart from foods there are many other sources of sodium One of the chief might be *drinking water* The sodium content of the drinking water of many major cities in the United States can be found in Table 124B in the Appendix Usually the local water department or the state department of health has this information Other sources of sodium might be water softeners tooth pastes mouthwashes and many medications such as cathartics and headache remedies

Sodium is used in many forms in *preparing or preserving foods* One of the most common is baking powder or baking soda Commercial breads contain sodium as well as cakes and cookies Recently low sodium bread has become widely available and to facilitate home baking if the calorie allowance and the diet permit low sodium baking powder may be purchased Prepared biscuit bread pancake and waffle mixes all contain salt

If one were to calculate from Table 124 the sodium content of foods it may be seen that salt free *bread* and butter are musts when sodium restriction is at a low level

Many *herbs* and *seasonings* do not contain sodium and may be used freely to improve the palatability of the diet Among those which are acceptable are allspice bay leaves caraway, cinnamon curry powder garlic marjoram nutmeg paprika parsley pepper (black white and red) sage thyme and vinegar Vanilla and almond extracts are allowed flavorings and other seasonings are dry mustard saccharine and fresh onion flavoring

In many cases a salt substitute is allowed Some contain sodium and others contain minerals which would not be advisable to all patients The physician prescribes which substitute, if any he recommends for the patient

The Newton Health Department of Newton, Massachusetts, has developed and published a booklet, *Planning Low Sodium Meals*, which is designed for the patient and physician It contains several diets of varying degrees of sodium restriction, developed as an exchange method similar to that of the diabetic exchange described in Chapter 30 It contains clear, descriptive information about the diets, the content of foods, and has many suggestions about the preparation of foods that are low in sodium Illustrations clarify what is meant by designated portions of food

Obviously, the severely restricted sodium diet should be adequate in all respects except sodium As soon as possible, the intake should be gradually increased Symptoms of nutritional deficiency as well as dehydration should be watched for

To summarize the diet in hypertension may be one of choice The plan may be moderation in diet and activity, the rice diet may be preferred or sodium restriction can be practiced Undernutrition or a reduction in weight may be the sole dietary treatment or it may be prescribed in combination with a restriction of sodium The future and additional controlled studies will give the answer to the most effective dietary management of hypertension

For the convenience of those engaged in the difficult task of planning low sodium diets, the figures on sodium values of food (Table 124) prepared by Mead Johnson and Company can be found in the Appendix

Other Circulatory Disorders

In coronary occlusion the primary concern is complete rest for the patient for the first 24 to 48 hours Little nourishment is given, although some institute the Karrell diet at this time (see Chapter 38) McLester and Darby suggest that the total fluid intake should be limited to 1 000 to 1 500 c c, but that there is no fixed rule Water and fruit juice may be offered during the acute stage, as well as milk

TABLE 113

ILLUSTRATIVE DIETS—THREE LEVELS OF SODIUM RESTRICTION*

FOOD	MILD RESTRICTION 1.53 GM SODIUM PRO—85, FAT—130, CHO—260 CALORIES—2,550	MODERATE RESTRICTION 0.515 GM SODIUM PRO—80, FAT—125, CHO—260 CALORIES—2,485	SEVERE RESTRICTION 0.2 GM (200 MG) SODIUM PRO—70, FAT—80, CHO—240 CALORIES—2,000
Milk	1 pint	1 pint	1 pint (low sodium)
Meat	5 or 6 oz	5 oz	3 or 4 oz
Egg	1 or another oz meat	1 or another oz meat	1 or another oz meat
Vegetables	3 or 4 servings	3 or 4 servings	4 or 5 servings‡
Bread or alternate	7 servings	7 servings (low sodium)	8 servings (low sodium)
Fat	12 servings (4 Tbsp.)	12 servings (unsalted)	10 servings (unsalted)
Cream	1 oz (2 Tbsp.)	1 oz	--------
Sugar, jam	9 tsp	9 tsp	6 tsp
Dessert†	1 serving	1 serving	(Made from foods from this list)
Fruit	3 or 4 servings	3 or 4 servings	4 or 5 servings§
Unsalted nuts	-------	-------	½ cup
Don't Use	Salt at the table Salt preserved foods, such as ham, bacon, dried beef, salted fish, olives, bologna or sausage, anchovies, sauerkraut, bouillon cubes, meat extracts Highly salted foods, such as salted nuts, potato chips, crackers Relishes, such as ketchup, pickles, prepared mustard, Worcestershire or meat sauces, celery salt, garlic salt Cheese (unless specially prepared without salt) Peanut butter (unless specially prepared without salt)	All foods omitted in mild restriction Salt in any kind of cooking Canned vegetables, meat, fish or soups (unless prepared without salt) Frozen peas, Lima beans, or frozen fish fillets Fruits preserved with benzoate of soda Shellfish, except oysters Salted fats, such as butter, margarine, and bacon fat Ordinary bread Anything cooked with soda, baking powder, prepared flour mixes, or prepared flours	All foods omitted in mild and moderate restriction Beets, carrots, celery, cooked greens of any kind Instant tea, instant coffee (some are processed without sodium), Postum, cocoa Milk (except dialyzed or low sodium) Dutch process cocoa Malted milk or Ovaltine

*Adapted from *Food for Your Heart* American Heart Association

†Puddings made from low sodium milk part of milk allowance jam, jelly, honey

‡Only these vegetables permitted asparagus avocado beans (green snap), Brussels sprouts cabbage corn cucumbers eggplant leaf lettuce mushrooms okra onions parsnips peas (fresh) peppers (green) potato (sweet or white) pumpkin radishes squash (acorn hubbard summer) tomatoes turnips (yellow) almonds beans (navy fresh Lima soy)

§Only one serving daily of cantaloupe fruit cocktail kumquats pears (canned) plums (canned)

As the patient progresses, the diet is usually slowly increased It may be both a low calorie diet and a soft diet which is low in sodium Diets varying from 400 to 1,200 calories have been suggested at different stages in the patient's illness Under nutrition, with its goal as a decreased basal metabolism and loss of body weight, is the basic principle in the dietary management of coronary occlusion The specific calorie prescription, the extent of sodium restriction, and the rate of increase cannot be generalized but must be determined for each patient

The patient with **angina pectoris** requires simple, easily digested foods which will place the smallest burden upon the digestive system Small meals with in between feedings are frequently suggested If the patient is overweight, it is usually recommended that he reduce In most cases the caloric intake is restricted Meat and coffee are allowed in moderation

A word about the relationship of nutrition to **rheumatic fever** There have been several surveys in the past twenty years which have sought to determine the nutritional status of children with this condition Considerable evidence has been obtained that nutrition is an important factor in the genesis of the rheumatic state, however, a single nutrient has not been isolated as being a sole deficiency, as the diets are usually inadequate in a number of nutrients Chief among them are protein, vitamins A and D, calcium, phosphorus, and iron Deficiency in vitamin C has also been reported Rheumatic fever itself is of doubtful origin though it is believed to be precipitated by an upper respiratory infection due to a group A hemolytic streptococci It is thought by many investigators that a host factor which is closely linked with nutrition either directly or through its effect on the state of immunity may explain why some children develop rheumatic fever and others do not Further studies may establish how the nutritional status of children, among other environmental factors as well, is responsible for the development of rheumatic fever Of further importance is the nutritional care of the child in the active and inactive stage of the disease (See discussion of fevers Chapter 29)

Review Questions

1 In what respects are the kidneys and the circulatory system interdependent?

2. At what point is systolic pressure of the heart considered abnormal or hypertensive?
3. What factors must be considered in planning dietary adjustment for a person with heart disease?
4. What are the principles of dietary treatment in the patient with congestive heart failure?
5. What is the difference between arteriosclerosis and atherosclerosis? Normal aging?
6. What are the various dietary adjustments recommended in atherosclerosis?
7. What are the principles underlying each one?
8. What are some of the contributory factors in hypertension?
9. What are the various dietary adjustments suggested for the patient with hypertension?
10. What are some of the principal objections to the "rice diet"?
11. To what extent may the diet be restricted in sodium?
12. How may the diet be adjusted for the patient with angina pectoris? Coronary occlusion?

Suggested Projects

1. Calculate the cholesterol content of your own menus. Which foods do you particularly enjoy that are rich in cholesterol? Can you easily substitute other foods for them?
2. Plan a week's menu for the Kempner Rice Diet, including as wide a variety as possible in ways of serving foods.
3. Calculate the nutritive value of one of the days included in Project 2. Which nutrients are below the Recommended Daily Allowances (without supplementation)?
4. Plan a diet that is severely restricted in sodium (Table 113) for a 45 year old man. Which difficulties did you encounter in fulfilling your prescription? Are you able to meet his nutritive requirements?
5. Plan several days' menus that are low in sodium and that use a variety of herbs and spices as seasonings. If possible, try some new combinations in your home to ascertain their acceptability.
6. Examine your own menus for foods high in sodium. Which foods would you have to omit from your diet if your intake were restricted in sodium?
7. Plan a restricted sodium diet for yourself. Follow this diet for a week. What problems did you encounter in adhering to this regimen? Did you become accustomed to the foods? Did you try any salt substitutes? Were they acceptable?

CHAPTER 40

THE ANEMIAS

Chief among the anemias are the deficiency anemias and pernicious anemia The former are due to a lack of iron or hemoglobin producing foods The latter is associated with the inability of the body to produce mature red blood cells There are also other groups of anemias The deficiency anemias are treated by a proper diet and iron therapy In some conditions folic acid is helpful Vitamin B_{12} is dramatically effective in pernicious anemia A high protein diet is usually indicated and frequently liver extracts are administered

The term anemia (*a*—without + *emia*—blood) denotes a diminution of the normal number or volume of red blood corpuscles or in the amount of hemoglobin in a unit of circulating blood The result of either condition is a lowering in the capacity of the blood to combine with and transport oxygen to the tissues The number of red blood cells or corpuscles (R B C) and the amount of hemoglobin (Hb) vary in normal persons with age, sex, geographic location and degree of activity and hydration of the individual However, certain approximate normal values may be assumed Five million red blood cells per cubic millimeter of blood may be considered average for men, for women the number is somewhat less The cells occupy 45% of the total volume of blood in any individual, the remainder, or 55%, is plasma Hemoglobin is present in the amount of 14 5 gm per 100 c c of blood or 14 5% of the total volume (see Chapter 9, Blood) Blood makes up *approximately* 7% of the body's weight, but it contains 70% of the body's iron Alteration in these values and consequent lowering in the oxygen supplied to the tissues produce symptoms such as headache, faintness, weakness, abnormal fatigue, increased sensitiveness to cold, irritability, and lack of power of concentration In severe anemia these are intensified and gastrointestinal upsets difficulty in breathing, heart murmurs etc , may be added to the symptomatology Certain symptoms are characteristic of a type of anemia and so are helpful as differentials

In order to build red blood cells, normal in kind and number, the bone marrow must have available protein, iron, vitamins B and C, and the thyroid hormone Further, once the cell is formed, it requires the stimulus of a substance produced in the stomach wall ("a specific erythrocyte maturing substance") if it is to mature and leave the bone marrow Under normal con ditions bone marrow produces 1,000,000,000,000 red blood cells a day In health, an equilibrium is maintained between blood formation and blood destruction, and if this is disturbed, anemia results The span of life of each red blood cell is probably from 60 to 90 days Eventually it is broken up and "scrapped for junk" after the iron is salvaged for re use The rest of the hemoglobin molecule is converted into bile pigment, and after playing its part here, it leaves the body by way of the feces to which it imparts the characteristic color

Anemias are described as hyperchromic or hypochromic, de pending upon the color index or upon the amount of hemoglobin present As is evident from the terms, hyper indicates that more than the average amount of hemoglobin is present, and hypo that the hemoglobin is below average The descriptive adjectives microcytic normocytic, and macrocytic may be used, in addition to indicate the size of the cells—less than average, average, or greater than average in size

Primary and secondary are terms formerly used in describing anemias, *primary* indicating failure of the bone marrow to pro duce normal red blood cells, and *secondary* indicating an anemia as the result of factors other than cell production, such as blood loss, food deficiency, pregnancy, etc This grouping is, however, being replaced by more detailed descriptions

Classification of the anemias is difficult because of the many complications and causes Several classifications have been sug-gested A simple one follows

Deficiency anemias Under this heading may be grouped the deficiencies due to lack of iron or hemoglobin producing foods Infants fed too long upon a milk diet frequently develop anemia due to the low iron content of milk In pregnancy, if intake of food is below utilization, or in any condition where the loss of red blood cells exceeds production by the bone marrow, as in hemorrhage, anemia results McLester and Darby suggest that

an iron deficiency anemia which occurs in adults should be considered evidence of current or past blood loss

Chlorosis, a disability occurring in young women, was encountered in years past, but today it is rarely described, probably because of better nutrition and diet, and the modern tendency to classify this condition simply as hypochromic anemia due to deficiency The anemia occurred usually at puberty, the period of rapid growth, or during the establishment of menstruation when the demand for iron is relatively great

Treatment of iron deficiency anemia rests on two basic principles (1) the correction of the inciting cause, if diagnosed and (2) the administration of iron, usually in the form of ferrous sulfate The excellent response to iron therapy in the hypochromic anemias suggests that the beneficial change in condition is due "to relief of a deficiency and not to a stimulation of unspecific nature since administration of iron to a normal individual or to one suffering from pernicious anemia, does not increase blood production"

Iron therapy is usually continued for 2 or 3 months at least Folic acid a member of the B complex (see Chapter 12), seems to be effective in anemia of pregnancy as well as in megaloblastic (giant corpuscles) anemia of infancy

In this group of deficiency anemias also belongs the anemia characteristic of scurvy, brought about by lack of vitamin C, the anemia found in pellagra and beriberi, caused by deficiency of the specific B vitamins (nicotinic acid and B_1), and the anemia which results from hemorrhage following a vitamin K deficiency with its subsequent prolonged clotting time

An anemia caused by lack of ability to absorb food normally, occurring in certain gastrointestinal disorders, also belongs to this group

Inadequacy of protein of high biological value and thyroid deficiency are other causes of anemia In fact, *anemia is often but one symptom of defective nutrition*

This second group of deficiency anemias is the result of inadequacy of or an abnormal utilization of food They may be treated primarily by proper dietary practice An entirely adequate diet, supplemented by the factor whose lack was responsible for the development of the anemia, is the treatment of choice in these

conditions The dietary history and the associated symptoms of the anemia usually reveal the underlying cause of the disease and indicate what factor or food constituent must be employed to rectify the condition and make the diet entirely adequate in all essentials for red blood cell construction

Certain foods notably liver promote blood regeneration out of proportion to their protein vitamin and mineral content The liver cell so intimately concerned with pigment metabolism apparently is the storehouse of the pigment complexes which are the parent substances of hemoglobin Considering liver as 100 per cent effective in the production of hemoglobin Whipple and his co workers arrive at the values given in Table 114

TABLE 114

Liver 100%
Chicken livers 90%
Gizzard kidney 80%
Apricots peaches 50%
Prunes raisins apples 35%
Lean meat 3[illegible]%
Sweetbreads and brains 25%
Green leaf vegetables 15%
Eggs 1[illegible]%
American cheese 1[illegible]%
Butter 1[illegible]%
Milk cream [illegible]%

Summarizing it can be seen that liver kidney and gizzard are the most potent sources of hematopoietic substance They have the greatest stimulating effect on cell production The group next highest includes apricots peaches apples and prunes Following these are the muscle meats and then a relatively inert group including the leafy vegetables dairy products and cereal grains

Iron or iron and copper medication may or may not be indicated in conjunction with the dietary change and its use is debated It is however of value in addition to high dietary intake of iron in many cases

Pernicious anemia or Addison s anemia (not to be confused with Addison s disease) is also a deficiency anemia since it is due to an inability of the body to produce the factor which has stimulating effect on the maturation of the red blood corpuscles known variously as the hematopoietic liver principle the erythrogenic liver principle and the antipernicious anemia principle or

factor The substance is apparently liberated in the gastrointestinal tract by interaction between some constituent of the gastric juice (called by Castle the *intrinsic factor*), and a water soluble dietary constituent known as the *extrinsic factor* which is found in many foods The iron supply is adequate but, lacking the intrinsic stomach factor, the individual is unable to manufacture his own liver fraction This intrinsic factor, when present, is stored in the liver, from whence it is released to stimulate the bone marrow to produce normal erythrocytes, and to release them to the circulating blood

In pernicious anemia achlorhydria (low gastric hydrochloric acid), gastrointestinal symptoms such as sore mouth, "beefy" tongue, loss of appetite, diarrhea or constipation, and abdominal pain occur

Today, on the basis of recent research, it is believed that pernicious anemia patients lack the intrinsic factor and therefore fail to absorb vitamin B_{12} effectively It is generally agreed that there is little understanding of the mechanism of action of the intrinsic factor beyond its ability to increase the absorption of vitamin B_{12} Usually, small amounts of the vitamin are effective in the treatment of pernicious anemia *Folic acid therapy is not* helpful in this condition

Before the discovery of vitamin B_{12} and its role in the treatment of pernicious anemia, "heroic" amounts of liver were served daily to the patient Liver was prepared in many ways such as homogenized in the form of a "liver cocktail," as a paté and used as a sandwich filling, and as the meat course for both dinner and supper Today, we recognize that the beneficial effect of these high liver diets lies in the fact that they contained large amounts of vitamin B_{12} Liver is still an excellent food for the diet of patients with pernicious anemia, however, a diet rich in protein, vitamins, and minerals is usually prescribed

In some cases liver extract is administered to the patient in pernicious anemia

A second group of anemias results from **interference with blood regeneration** of such nature that red blood cell elaboration (hematopoiesis) cannot take place

There may be physical injury to the blood forming organs by prolonged radiation x ray, radium and accidental absorption of radioactive material (in industry)

Mechanical interference with blood forming organs due to obliteration of potentially active bone marrow (despite the maximum productivity of the remainder) results in an inadequate number of red blood cells Carcinoma acute and chronic leucemias miliary tuberculosis or Hodgkin's disease, and occasionally tumors in the bones and osteosclerosis (pathological bone marrow change) may be the causative agent

There are also idiopathic disturbances of the blood forming organs ' for which there is no immediate explanation'' aplastic anemia (where cells are not formed in the bone marrow), the macrocytic anemia of liver disorders especially of cirrhosis the so called splenic anemia and certain congenital erythroblastic anemias (anemia of the premature infant or the type variously called Mediterranean or Cooley's anemia, which was described first by von Jaksch and is occasionally called by his name)

Finally there are anemias caused by actual **disintegration of the blood** by the action of infective organisms intestinal worms cancer extensive burns or hemolytic poisons In these dietary adjustment other than directed toward improvement of general health is ineffective

Review Questions

1 What does the term anemia denote?
2 What is the average number of red blood cells per cubic millimeter of blood in healthy men?
3 What amount of hemoglobin in 100 c c of blood is considered normal?
4 Where are red blood cells formed?
5 What nutrients are essential to the formation of red blood cells normal in kind and number?
6 What is *necessary for their maturation?*
7 What is meant by deficiency anemias?
8 What are the dietary indications in deficiency anemias?
9 What foods have been found especially valuable in blood regeneration?
10 In what respect does pernicious anemia differ from other deficiency anemias?
11 What are the fundamentals of treatment in pernicious anemia?
12 In addition to the above what are some other believed causes of anemia?

CHAPTER 41

FOOD ALLERGY

One of the greatest challenges in dietotherapy is the diagnosis and treatment of food allergy Modified diets are used extensively "Elimination" diets, "allergy free" diets, and "provocative" diets are often part of diagnostic methods in allergy Care must be taken to provide nutritionally adequate meals throughout these periods of extreme restriction Once the offending food has been determined, ingenious means are frequently necessary to provide a wholesome and varied diet

There is nothing new about allergy except the name itself, *which indicates altered reactions or abnormal response* Certain individuals, for some unknown reason, are hypersensitive to certain substances Such people break out in a rash, develop hives, sneeze, suffer from asthmatic attacks, severe headaches ringing and pressure in the ears, or are afflicted with flatulence, cramps, nausea, diarrhea, or vomiting Why? Scientists wish they knew Apparently abnormal cell reaction of some kind is the cause If the irritable cells are in the nose, sneezing develops, if in the throat, coughing results, if in the stomach nausea cramps, and even vomiting, may follow, and if in the lungs wheezing or asthma occurs

While any one of the symptoms may result from contact with the offending substance, there is a tendency for certain substances to cause reactions in somewhat localized areas, for instance, asthma or respiratory tract irritation usually results from the pollens, dust, feathers, or from the dairy products Wheat and other cereals are frequently the causative agent for migraine (a specific type of headache) Milk, eggs, cereals, and pork should be suspected first in skin rash Strawberries, tomatoes, chocolate and fish are the most frequent cause of hives Food allergies must not be confused with food poisoning (see Chapter 17) vitamin deficiencies (Chapters 11 and 12), or with dermatological conditions

Rinkle and his associates in an extensive monologue devoted to food allergy, have defined food allergy as "a term used in refer

ence to those foods for which it is possible to demonstrate a cause and effect relationship between the ingestion of a specific food and the production or accentuation of allergic symptoms This relationship must not only exhibit specificity but it must be demonstrable repeatedly and upon every occasion when the tests are performed correctly'



Fig 70 Infantile eczema in a child sensitive to milk and eggs (From Sutton and Sutton An Introduction to Dermatology The C V Mosby Co)

Unfortunately allergy has been exploited to such an extent that it has become in many instances a fad resulting in dietary maladjustment There are undoubtedly many unrecognized food sensitivities existing that cause preventable ill health When the sensitivity is real it is of great importance that dietary adjustment be made but it is of equal importance that the diet be so planned that deficiencies do not result Careful substitution is necessary and padding with commercial products may be im

perative Diets for allergic conditions should always be super vised by someone trained to recognize nutritional needs, who understands biological relationships of foods, and who can ferret out minor causative factors that may be obscure to the casual observer In allergy the fault lies in the body cells, not in the food The offending material may be one or more of a vast number

TABLE 115

FOODS FREQUENTLY CAUSING ALLERGIC SYMPTOMS ARRANGED IN ORDER OF FREQUENCY

FOOD	FRE QUENCY	FOOD	FRE QUENCY
Wheat	61	Grapefruit	3
Chocolate	44	Pineapple	3
Egg	35	Ginger	3
Milk	26	Lettuce	3
Beans	21	Mint	3
Peas	18	Oats	3
Potato	17	Lamb	3
Tomato	16	Spices	3
Corn	16	Cinnamon	3
Beef	15	Carrot	3
Onion	15	Strawberry	2
Pork	13	Sweet potato	2
Fish	13	Cucumber	2
Nuts	10	Cherry	2
Cantaloupe	*9*	Cheese	2
Peanut	8	Cauliflower	2
Black pepper	8	Cocoanut	2
Chicken	6	Green pepper	2
Asparagus	6	Tea	1
Orange	5	Raspberry	1
Apple	4	Blackberry	1
Grape	4	Cloves	1
Cabbage	4	Garlic	1
Rice	4	Rye	1
Liquor	4	Veal	1
Peach	3	Mustard	1
Spinach	3	Celery	1
Almonds	3	Plum	1
Watermelon	3	Lemon	1

From Eyermann Food Allergy as a Cause of Vasomotor Rhinitis South M J 31 210 1938 Reproduced from Hawley Maurer Mast The Fundamentals of Nutrition Charles C Thomas

Eyermann has listed, in Table 115, the frequency with which foodstuffs induced symptoms of nasal allergy in his series of 181 cases.

Although an allergic attack may be caused by food, house dust feather pillows, the horse, dog, or cat, some garden plants and

weeds a brand of face powder, and other things only food allergy will be discussed here

Treatment in all types of allergy is essentially the same namely desensitization or the avoidance of the offending substances There is no real difference between the various types of allergic reactions Fundamentally they are all manifestations of the same abnormal condition of hypersensitivity Symptoms may be mild or severe they may occur almost at once or they may be delayed from half an hour to several days The longer time complicates the picture and obscures the cause

While food allergy generally results from the ingestion of the food the mere handling of it may precipitate an attack and unbelievably minute traces may cause an attack in a highly sensitive person The meat of the hen has been reported as bringing on an allergic attack in a person sensitive to egg whereas the same individual could eat rooster meat with impunity Or an attack may result only when large amounts of an offending material are ingested The strange forms in which the sensitivity manifests itself may at times be very misleading All these factors tend to make allergy a fascinating study but one requiring ingenuity and intelligent cooperation from the patient

Allergy frequently occurs in more than one member of a family or in succeeding generations The tendency to be sensitive is not always transmitted with the symptoms in the same form nor does the same form always exist in the same person throughout life A child may exhibit eczema in infancy and apparently outgrow it and suffer later from asthma for some years only to have this yield to gastrointestinal symptoms

Diagnosis is difficult Several methods in addition to careful history are suggested Food extracts are injected into the superficial layers of the skin in the skin test In the scratch test a drop of the food extract is placed on a scratch made on either the arm or the back A positive reaction following the contact between body cells and the prepared allergens (the extracts of suspected substances) may help to implicate an offending substance These tests are not infallible but may be indicative The positive test consists in the development of an urticarial wheal or raised area surrounded by an erythematous or reddened zone The "leucopenic index is also sometimes used This is based on the assumption that following digestion of a food to which

the patient is sensitive, the total leucocyte count in the blood usually falls It is probable that the only reliable method for detecting the causative agent is through a carefully kept diary of the food eaten, activities, and environment This, if sufficiently complete with comments on personal physical reactions to give a fair history of the patient, and used with elimination diets, may enable the doctor to discover the cause of the reaction It may be a combination of circumstances or foods or an additive effect of several factors, each causing reactions too mild to arouse suspicion A history of previous health and family ailments may furnish the clue The history outline suggested by Tuft in his *Clinical Allergy* is well worth reading

Treatment of allergy is aimed toward the removal of the causative agent Diets designed to eliminate specific foods are known as elimination diets They consist of carefully worked out food combinations based on the premise that if an individual is sensitive to a given food, he will undoubtedly react similarly to other foods belonging to the same biological family Rowe, the pioneer in this method of treatment, has worked out four diets which bear his name and are known as Nos 1, 2, 3, 4 Each diet eliminates certain foods or food groups and emphasizes others

By following a diet for a period of days it is possible to ascertain whether the foods contained in the diet, or eliminated from the diet, are responsible for the attacks Unfortunately, milk, eggs, wheat, and potatoes, especially the first three, are the chief offenders A milkless wheatless, eggless diet will alleviate the symptoms if one of these foods is the offender After a few symptomless days, the cautious addition of first one and then another of these foods will indicate, perhaps, that only one is the offender If so that food must be eliminated from the diet in every form If eggs, not only eggs as such, but cakes, pies, puddings made with eggs Noodles and baking powder, if made with eggs, must be avoided *One must know the ingredients used in prepared foods* (See Appendix Table 127 for list of foods and possible allergens they contain)

Alvarez begins even more cautiously in his treatment The first diet consists only of lamb rice, butter, sugar, canned pears, or gelatin These, experience has taught him, are less liable to cause reactions than other foods No pepper, sauces, cream, or drink of any kind except water, is allowed If no reaction re

TABLE 116

ELIMINATION DIETS

DIET 1	DIET 2	DIET 3	DIET 4
Rice	Corn	Tapioca	Milk*
Tapioca	Rye	White and sweet potato	
Rice biscuit	Corn pone	Lima bean potato bread	
Rice bread	Corn rye muffin	Soya bean lima bean bread	
	Rye bread		
	Rye crisp		
Lettuce	Tomato	Beets	
Spinach	Squash	Carrots	
Carrot	Asparagus	Lima beans	
Beet	Peas	String beans	
Artichoke	String beans	Tomato	
Lamb	Chicken	Beef	
	Bacon	Bacon	
Lemon	Pineapple	Lemon	
Grapefruit	Peaches	Grapefruit	
Pears	Apricot	Peaches	
	Prunes	Apricot	
Cane sugar	Cane sugar	Cane sugar	
Wesson oil	Mazola oil	Olive oil	
Olive oil	Wesson oil	Wesson oil	
Salt	Salt	Gelatin	
Gelatin	Karo corn syrup	Salt	
Syrup made of maple sugar or cane sugar flavored with mapleine or maple sugar	Gelatin	Olives	
Olives		Maple syrup or syrup made with cane sugar flavored with maple	
Pear butter			

*Milk should be taken up to two or three quarts a day Tapioca cooked with milk and milk sugar also may be taken

Note —Wesson (cottonseed) oil is included in all diets With allergy to cottonseed as shown by skin test or history this must be excluded and a cotton seed oil shortening such as Crisco must not be used If allergy to cane sugar is suspected beet sugar or corn glucose may be used (Copied from Vaughan The Practice of Allergy The C V Mosby Co See Appendix for additional suggestions

sults during the ingestion of this diet (a food diary is kept) other foods are slowly added potato cream asparagus carrots string beans oatmeal and dextrinized bread over a period of two weeks With sufficient time interval between additions, it is possible to determine tolerance for each food Milk eggs plain bread and other foods then may be added in turn See Table 117 for botanical grouping of foods

TABLE 117

The following edible foods are arranged in accordance with their botanical classification, in such a way that one may readily recognize those which are botanically related and which might cross react *

(1) *Seaweeds*
Agar agar
Irish moss

(2) *Fungi*
Mushrooms
Truffle
Puff balls
Molds
Yeast

(3) *Gymnosperms*
Pine nut

(4) *Cereal Grains*

Wheat	Barley	Oat	Wild rice
Rye	Malt	Rice	Corn

The cereal grains and potato provide the chief source of starchy food Occasionally nearly all of the cereal grains must be avoided In this case the following sources of starchy foods, not closely related to other foods may be drawn upon

Arrowroot Cassava Tapioca
Sago (Florida Arrowroot or Indian Bread Root)

(5) *The Palm Family*
Cocoanut Date Jujube

(6) *Pineapple* This fruit is not closely related to any other food

(7) *Banana* This also has no closely related food

(8) *The Lily Family*
Onion
Garlic
Chive
Leek
Shallot
Asparagus

(9) *The Mulberry Family*
Mulberry
Hop
Fig
Breadfruit

(10) *The Buckwheat Family*
Rhubarb
Buckwheat

(11) *The Walnut Family*
Walnut
Pecan
Hickory

(12) *The Beech Family*
Chestnut
Filbert
Beechnut

(13) *The Beet Family*
Swiss Chard
Beet
Spinach

(14) *The Gooseberry Family*
Currant
Gooseberry

(15) *The Cabbage or Mustard Family*
Turnip
Rutabaga
Cabbage
Kale
Collard
Cauliflower
Broccoli
Brussels Sprouts
Kohlrabi
Mustard
Radish
Horseradish
Water cress

(16) *The Rose Family*
Strawberry
Raspberry
Blackberry
Dewberry
Logenberry

(17) *The Apple Family*
Apple
Apple Butter
Crab Apple
Quince
Pear

Apple pectin is widely used in commercial jellies such as mint jelly and in some candy such as Turkish paste and gum drops

*Vaughan Warren T Primer of Allergy St Louis 1953 The C V Mosby Company

TABLE 117—CONT'D

(18) *The Plum Family*
- Peach
- Nectarine
- Apricot
- Almond
- Plum
- Prune
- Cherry

(20) *The Flax Family*
- Flaxseed (Linseed)

(22) *The Pistachio Family*
- Pistachio nut

(23) *The Grape Family*
- Grape
- Raisin
- Currant (dried)
- Wine
- Brandy
- Grape Vinegar
- Grapejuice

(25) *The Chocolate Family*
- Chocolate
- Cocoa
- Cocoa butter

(28) *The Laurel Family*
- Cinnamon
- Avocado or alligator pear
- Bay leaves

(29) *The Huckleberry Family*
- Huckleberry
- Blueberry
- Cranberry

(30) *The Olive Family*
- Olive

(31) *The Morning Glory Family*
- Yam
- Sweet Potato

(33) *The Potato Family*
- Irish potato
- Tomato
- Red and green peppers
- Eggplant

(36) *The Thistle Family*
- Lettuce
- Salsify (oyster plant)
- Endive
- Chicory
- Jerusalem artichoke
- Artichoke
- Dandelion

(19) *The Legumes*
- Lentil
- Kidney bean
- Lima bean
- String bean
- Blackeye pea
- Soybean
- Pea
- Peanut
- Peanut butter

(21) *The Citrus Family*
- Citron
- Orange
- Tangerine
- Bergamot
- Lemon
- Grapefruit
- Lime
- Limequat
- Kumquat

(24) *The Mallow Family*
- Cottonseed
- Okra (gumbo)

(26) *The Tea Family*
- Tea

(27) *The Carrot Family*
- Carrot
- Parsnip
- Parsley
- Celery
- Celeriac
- Fennel
- Caraway seed
- Coriander
- Anise seed
- Dill

(32) *The Mint Family*
- Mint
- Sage
- Savory

(34) *The Coffee Family*
- Coffee

(35) *The Gourd Family*
- Squash
- Pumpkin
- Cucumber
- Cucumber pickle
- Watermelon
- Cantaloupe
- Muskmelon

When the offending food is finally isolated, a new set of recipes must be followed, and vigilance must be maintained to prevent the ingestion of the food in some unsuspected form. Fortunately, many food manufacturers are stating accurately on food pack

ages the constituents making up the food A number of milk less, eggless, wheatless suggestions and recipes are available (see Appendix), and with careful planning a fairly normal diet may be obtained for the victim of allergy, even though the sensitivities are several During the use of elimination deits, care must be taken that nutritional deficiencies are met by vitamin and mineral supplementation This is especially important when the patient is a child It has been suggested by some that the patient should not remain on a single elimination diet longer than two weeks

An alternate approach to the elimination diets has been proposed by Lee and Squier They suggest, unless previous findings indicate otherwise, that a "provocative diet" be used in the recognition of food allergy This constitutes a diet of wheat, milk, egg, beef, orange, and potato Only these foods, which are the foods most often responsible for allergy, are given for about a week If the patient is sensitive to any of these foods, it can probably be detected within this time If there is no indication of a food allergy, then other foods can be added to this basic diet It would seem that one of the advantages of this approach to the detection of food allergies is the flexibility and nutritional adequacy of the foods included in the test diet

Frequently heating a food will alter its structure favorably Many children who cannot drink raw, pasteurized or dried milk, can take boiled milk or evaporated milk A person sensitive to corn may take corn syrup Prolonged cooking or toasting of cereals and cereal products sometimes renders them nonreactive, where the usually prepared cereal would be

A statement by Vaughan will serve as a summary "The most *successful therapeutic program in food allergy consists* in (a) searching for and finding the offending allergens, (b) their elimination from the diet, (c) the providing of an adequate dietary program with substitute foods (d) food additions as rapidly as the patient's tolerance will permit When avoidance is impossible, desensitization, either orally or parenterally, may be attempted, although this method is usually not as successful There is evidence that the natural tendency is toward loss of sensitization provided the tissue response is not repeatedly restimulated by recurrent exposure to the allergen After sensitization has been lost, following avoidance, the patient often finds that he can again eat the offending food in moderation"

Review Questions

1 What does the term allergy mean?
2 What are some of the symptoms of allergy?
3 Does food allergy indicate food poisoning?
4 What two treatments are used for allergy?
5 Is food allergy always caused by the ingestion of the offending food?
6 Is allergy an inherited characteristic? Explain
7 What methods are used to diagnose an allergy?
8 What is the purpose of the Rowe elimination diets?
9 What diet regime is used by Alvarez?
10 What foods most frequently cause allergies?
11 How does Vaughan summarize a successful therapeutic program in food allergy?
12 Does a hypersensitive person remain so through life?

Suggested Projects

1 Examine your own menus How many times does wheat appear in one day? In what ways does wheat appear in the diet? How could you modify your menus to exclude wheat entirely from your food?
2 Examine menus as suggested in problem 1 but in reference to the milk consumption in the diet If you were allergic to milk and milk products, calculate a diet pattern that would provide the nutrients normally supplied by milk How difficult would this be to maintain in the daily diet?
3 Obtain some of the hypoallergic milks Compare them in respect to taste, price, and ease of cooking with the usual cow's milk If it were necessary for a family to use one of these milks for one member of the family, what are the difficulties which would ensue in the family meal service?
4 If you were allergic to wheat what would be your luncheon menu if you ate away from home? Would such a menu fit into your current food budget?

CHAPTER 42

SUMMARY OF DIET THERAPY

It is hoped that the foregoing pages have re emphasized the original premise stated—that the *diet in any clinical condition should and can be made by adjustments in the normal diet pattern;* that the body as a whole is more important than any individual part and it must not be sacrificed for any one dysfunction A midcourse is frequently necessary for this end—concession to total body needs For assurance of adequacy of a therapeutic diet, the final diet should be checked *against the accepted standard requirements*

In Table 118 there is an outline indicating variations from the normal and in Table 119 these data are further summarized Also see Table 3 for review of normal recommended allowances

TABLE 118

NORMAL CONSTITUENTS AND VARIATIONS FROM THE NORMAL CONSTITUENTS OF THE DIET (ADULT)

Calories	*35 to 100* calories per kilogram per 24 hours, depending upon age and activity, or the height in inches times 40 calories per inch with reasonable deviation for metabolic activity, physical activity, and desired weight *Increased* in malnutrition, end of pregnancy, fevers, when metabolic rate is elevated *Decreased* in obesity, *usually in diabetes, hypertension,* gout, arthritis, hypothyroidism
Protein	1 to 1 5 gm per kilogram for adult—10 to 15% of total calories, 2 to 3 gm per kilogram for growing child *Increased* in pregnancy, lactation, recovery from illness, malnutrition, when albuminuria is present and when serum proteins are low (nephrosis), in colitis, liver disease, typhoid, gastrointestinal tract disturbances, especially peptic ulcer and ulcerative colitis *Decreased* in acute nephritis and uremia, moderate intake (as with all food) in cardiac disease or hypertension In gout the diet should be low purine, therefore restriction of *certain proteins (nucleoproteins)*
Fat	1 to 2 gm per kilogram of body weight, 25 to 40% of total calories, a total of 75 to 150 gm in adult diet *Increased* in epilepsy, malnutrition, constipation, tuberculosis urinary tract infections, in most high caloric diets, and in some diabetes and hypoglycemia *Decreased* in certain liver disturbances, celiac disease, steatorrhea, pancreatitis, anemia, decreased gastric motility

TABLE 118—CONT'D

Carbohydrate	4 to 5 gm. per kilogram of body weight, 40 to 50% of the total calories. A total of 300 to 400 gm. in adult diet *Increased* in liver and gall bladder disease, cardiac disease, acute nephritis and uremia, all fevers except tuberculosis, nausea and vomiting, high caloric diets, to overcome intestinal putrefaction *Decreased* in epilepsy or in the ketogenic diet, in tuberculosis, and in some diabetes and hypoglycemia

When percentage distribution of calories is used instead of grams of nutrient per kilogram of body weight of individual, the value expresses the need for the child as well as the adult and properly fluctuates with the caloric change. These facts make the caloric ratio valuable as a calculating aid.

Vitamins*	A—5,000 to 8,000 I.U. daily Thiamine—0.3 to 1.9 mg. daily Riboflavin—0.4 to 2.5 mg. daily Niacin—3 to 19 mg. daily C—30 to 150 mg. daily D—400 I.U. E, K, and other members of the B complex—requirement unknown Specific vitamin therapy in the deficiency or subclinical conditions due to their lack *Increased* general vitamin therapy in pregnancy, lactation, fevers or other conditions of metabolic increase, gastrointestinal disorders or lesions
Minerals	Ca 0.8 to 2 gm. P 1 to 1½ gm. Fe 12 to 15 mg. *Increased* in pregnancy and lactation, growth, and anemia. Alteration in intake of Na and K in Addison's disease *Decrease* in K and increase in Na in Addison's disease; restriction of NaCl from usual 10 to 20 gm. to maintenance level of 1 to 3 gm. in edema. Acid-base balance shift to combat urolithiasis or urinary tract infection
Water	1 to 2 liters daily *Increased* in fevers, certain kidney disorders, dehydration, Addison's disease, constipation *Decreased* in edema, renal insufficiency, epilepsy
Indigestible fiber	*Increased* in atonic constipation and obesity *Decreased* to produce smooth or soft diet for gastrointestinal lesions, spastic constipation, malnutrition, high caloric diets
FA:G	Normal ratio 0.8:1, diabetes 1:1, borderline 1.5:1, ketogenic level 3:1
Acid-base balance	The normal diet is neutral or somewhat alkaline The acidic diet is used to facilitate the solution of phosphates, while the basic or alkaline ash diet is effective when urates, oxalates, or cystine tend to precipitate Adjustments may also be of value in combating infections

*Refer to Table 3 for details of 1953 revision

TABLE

A SUMMARY OF MODIFICATIONS OF THE

	HIGH PROTEIN	LOW PROTEIN	HIGH CALORIE
Milk, cheese	1 qt milk, milk drinks, nonfat dry milk solids, all cheese	1 cup milk—all forms or ¾ oz cheddar cheese or equivalent amounts other cheese	1 qt milk, milk drinks, added non fat dry milk solids, all cheese
Meat, fish, poultry, eggs	6 to 8 oz. E.P. all meat, fish, poultry, 1 or more eggs	2 oz. E.P all meat, fish, poultry 1 egg instead of 1 oz meat	6 to 8 oz. E.P all meat, fish, poultry
Bread, cereal, cereal products	6 to 8 servings—preferably whole grain or enriched	4 servings—preferably whole grain or enriched	6 or more servings, preferably whole grain or enriched
Potato	1 serving—all potato	1 serving—all potato	1 or more servings—all potato
Vegetable, green, leafy, or yellow	1 or more servings—all vegetables, raw or cooked	1 serving—all vegetables raw or cooked	1 or more servings All vegetables, raw or cooked
Vegetable, other	1 or more servings of all vegetables, raw or cooked	2 servings of all vegetables, raw or cooked	1 or more servings—all vegetables, raw or cooked
Fruit, citrus	1 or more servings of all citrus fruits, as juice or as fruit	1 serving of all citrus fruits, as juice or as fruit	1 or more servings o all citrus fruits as juice or as fruit
Fruit, other	2 or more servings, as juice or fruit, raw, cooked, canned, or dried	2 servings, as juice or fruit, raw, cooked, canned, or dried	2 or more servings a juice or fruit, raw, cooked, canned, or dried
Fats	3 or more tablespoons—all fats	3 or more tablespoons—all fats	3 or more tablespoons—all fats
Miscellaneous	All desserts, beverages, condiments, soups, sweets, pickles, relishes, spices, herbs, vinegar, white sauce	Coffee, carbonated beverages tea, most condiments, herbs, clear candy, jams, jellies, syrups, honey, vinegar, soups and desserts made with foods listed above	All desserts, beverages, condiments soups, sweets pickles relishes, spices herbs vinegar, whit sauces In between feedings, emphasis upon evening snack

9A

sic Diet to Meet Therapeutic Needs

LOW CALORIE	LOW PURINE	BLAND
pt milk, skim milk referred, cottage heese may be substi ute l	1 pt or more milk, all forms, all cheese	1 pt. or more milk, milk drinks, cottage, cream, farmer cheese
o 6 oz. E P. lean eat, fish, poultry, roiled or roasted, 1 gg poached, soft or ard cooked	Limited amounts of beef, veal, lamb, mutton, pork, pork products, game, fowl, fish, shellfish Others re stricted (see below) 1 or more eggs	1 oz or more E P.; tender, well done, broiled or roasted meat, fish or poul try, whole or minced. Eggs poached, soft or hard cooked or scrambled in double boiler
servings, preferably hole grain or en iche l	4 or more servings, prefer ably whole grain or en riched	4 or more servings toasted refined enriched bread; re fined cereals, crackers from refined flour
ibstitute 1 small baked otato for 1 serving f bread, etc	1 or more servings	1 or more servings mashed, baked (served without skin), boiled, escalloped, creamed
or 2 servings—all veg tables, raw or cooked	1 or 2 servings—all vege tables, raw or cooked Limited amounts—aspara gus, peas, spinach, string beans	1 or more servings cooked tender whole, or purée
or 2 servings—all veg tables other than hose liste l below	2 or more servings all vegetables, raw or cooked Limited amounts—shell beans, lentils, mushrooms	2 or more servings cooked tender whole, or purée
or 2 servings of citrus fruit, as juice or as fruit	1 or more servings of citrus fruit, as juice or as fruit	1 serving strained dilute orange juice, other citrus juices as tolerated
or 2 servings as juice or fruit, raw or cooked, anned without sugar	2 or more servings as juice or fruit, raw, cooked, canned, or dried	1 or more servings cooked or canned without skins or seeds, puréed fruits, dried fruits
tablespoons—all fats	3 or more tablespoons— all fats	3 or more tablespoons cream, butter, fortified margarine
lear coffee, tea, cereal beverages, unsweetened carbonated beverages, clear bouillon or con sommé, spices, herbs, vinegar; condiments, pickles, relishes in lim ited amounts, artificial sweetener	All beverages, desserts, rich desserts in modera tion, condiments, herbs, pickles, relishes, spices, nuts, all sweets	Tea and coffee as tolerated, desserts of gelatin, pud dings, cream soups made with purée of vegetables; salt, white sauce; sugar in moderation

TABLE

On			
	therapeutic purposes	bread, cereal, cereal products, potato, vegetables, fruits, eggs, desserts and soups made from milk or eggs in addition to amounts *above*	therapeutic purposes

119A—CONT'D

LOW CALORIE	LOW PURINE	BLAND
Additional amounts of food other than those listed above, sweets, as candy, sugar, jam, jellies, syrups desserts, sauces, as Hollandaise, gravy, white sauce; foods preserved in oil; dried fruits; fried foods, high calorie vegetables as corn, lima beans, legumes; fruits preserved in sugar syrup	Meat extracts, broth, gravy; liver, kidney, sweetbreads, sardines, anchovies, herring, mackerel, roe, scallops, mussels, partridge, and squab; mincemeat; fried meat; fried potato, potato chips, alcohol, yeast	Fried potatoes, potato chips; tough, fibrous meats, fried and rare meats; meat extracts, broth, bouillon, gravy; fried eggs; strong flavored, highly seasoned, and American cheese; whole grain bread, cereal, cereal products; raw or tough fibrous vegetables; raw fruits or skins and seeds or fruits; carbonated beverages; sweets (other than above); nuts, alcohol, condiments, relishes, pickles, spices, vinegar; salad oils

TABLE

	LOW RESIDUE	HIGH RESIDUE
Milk, cheese	Cottage, cream cheese, American cheese used for flavoring	1 pt or more milk, milk drinks, all cheese
Meat, fish, poultry, eggs	4 oz or more E P, tender, well done broiled or roasted meat, fish, or poultry, whole or minced Eggs poached, soft or hard cooked, or scrambled in double boiler	4 oz or more E P; all meats, fish, poultry; 1 or more eggs
Bread, cereal, cereal products	4 or more servings, enriched white bread, refined cereals, crackers from enriched flour	4 or more servings, whole grain bread, cereal, cereal products
Potato	1 or more servings mashed, baked (served without skin), boiled, escalloped, creamed	1 or more servings, potato with skin
Vegetable, green, leafy or yellow	1 or more serving canned or cooked puree	1 or more serving all vegetables, one served raw
Vegetable, other	2 or more servings canned or cooked puree, vegetable juices	2 or more servings, all vegetables, one served raw
Fruit, citrus	1 or more servings strained citrus juice	1 or more servings of citrus fruit
Fruit, other	1 or more servings strained fruit juice, puréed, cooked or canned fruits, avocado, ripe banana, canned or cooked fruits without skins or seeds	1 or more servings, all fruits, raw, cooked, canned
Fats	3 or more tablespoons cream, butter, fortified margarine, vegetable oils	3 or more tablespoons—all fats
Miscellaneous	Tea, coffee, cereal beverage, carbonated beverage, broth, bouillon, clear candy, sugar, jelly, honey, syrup, gravy, salt, vinegar, spices without residue, angel food, sponge cakes, gelatin desserts, sherbets	All desserts, beverages, condiments, soups, sweets pickles, relishes, spices, herbs, vinegar, white sauce

119B

SOFT—HIGH CELLULAR	LOW SODIUM	LOW FAT
1 pt or more milk, milk drinks, all cheese (except those listed below)	1 pt milk or dialyzed milk	1 pint milk, whole or skim, cottage cheese, cheese made from skim milk
4 oz or more E P tender, well done, broiled or roasted meats, fish, poultry, 1 or more eggs	4 oz E P. meat, fish, poultry (except those listed below), prepared without salt, 1 or more eggs poached, soft or hard cooked or scrambled in a double boiler	4 oz or more E P. lean meat, fish, poultry, broiled or roasted; 1 egg, poached, soft or hard cooked or scrambled in a double boiler
4 or more servings enriched white bread, refined cereals, crackers from refined flour	4 or more servings whole grain or enriched bread, cereal or cereal products, or same in low sodium foods	4 or more servings whole grain or enriched
1 or more servings mashed baked (served without skin), boiled, escalloped, creamed	1 or more serving potato (except listed below) cooked without salt	1 or more serving, baked, mashed, or boiled
1 or more serving cooked tender, whole vegetables	1 or more serving all vegetables, raw or cooked, prepared without salt (except those listed below)	1 or more servings all vegetables, raw or cooked
2 or more servings cooked tender whole vegetables	2 or more servings all vegetables raw or cooked, prepared without salt (except those listed below)	2 or more servings, all vegetables, raw or cooked (except those listed below)
1 or more servings of citrus fruit, fruit juice	1 or more servings of citrus fruit fruit juice	1 or more servings of all citrus fruits as juice or fruit
1 or more servings, all fruits, cooked, canned	1 or more servings all fruits cooked canned (except those listed below), "gas forming" if tolerated	2 or more servings of all fruits as juice or fruit, raw cooked, canned, or dried
3 or more tablespoons—all fats	*3 or more tablespoons* cream sweet butter	*3 tablespoons (more if tolerated)* of butter, fortified margarine cream (20%) salad oil
All desserts (except those listed below), beverages soups sweets, white sauce	Desserts prepared from foods above without salt, cereal beverages coffee, tea, unsalted soup prepared from allowed foods, sugar pure sugar candy honey jam jelly or marmalade prepared without salt, chocolate herbs some spices, unsalted prepared foods	All beverages, gelatin desserts, ice cream, puddings in moderation, sherbet, angel food cake, clear candy honey, jam, jelly, molasses, sugar, herbs, salt vinegar, some spices

TABL

	LOW RESIDUE	HIGH RESIDUE
Omit	*Milk, milk drinks, cheese other than that listed above, tough, fibrous meats fried meats, fried eggs, whole grain bread, cereal, cereal products, raw fruits, fruits with skins and seeds, raw and cooked whole vegetables, desserts other than those listed above or prepared from foods other than those allowed, candy containing nuts, jams or marmalade, nuts, pickles, relishes, fried potato	Fruit and vegetable juices purée of fruit and vegetables

*Some omit milk and milk drinks

119B—CONT'D

SOFT—HIGH CELLULAR	LOW SODIUM	LOW FAT
Highly seasoned, strong flavored cheese, raw fruits and vegetables, rich desserts, condiments, pickles, relishes, spices, herbs, vinegar	Buillon, consommé, carbonated beverages, desserts made with baking powder, baking soda, quick cooking cereals, commercial gelatin desserts, milk other than listed above; bacon, salted or smoked meats, fish or poultry, frozen and canned fish, canned meats and poultry, all cheese, shellfish, molasses, syrups, most dried fruits, frozen and canned vegetables, *beets, celery*, chard, dandelion greens, kale, spinach, relishes, condiments pickles, salted nuts olives salt, some public water	Heavy cream, fried potato, fatty meats and fish, cheese other than listed above, foods canned in oil, desserts high in fats, avocado, raw apple, melon, chocolates, "gas forming vegetables" as those of the cabbage family, dried peas rutabagas, turnips, dried beans

See text for details In most cases, diets are calculated for individual patients and the degree of restriction will be varied This is especially true in diets low in calories, protein, sodium and fat

PART IV

QUESTIONS FOR GENERAL REVIEW

1 What is meant by the term metabolism?
2 Under what conditions is basal metabolism measured? Why?
3 Show by calculation your approximate caloric requirements?
4 What factors would influence this value?
5 What is the purpose of digestion?
6 What are the end products of protein digestion?
7 What value would there be in having an analysis of the stool?
8 What role does the circulation of blood play in nutrition?
9 What is meant by the term anemia?
10 Does any relationship exist between the mind and food utilization?
11 What influence do the endocrines exert on one's state of nutrition?
12 Name four endocrines
13 How are foods classified?
14 What is meant by the biological value of a protein?
15 Can proteins "supplement" one another? How?
16 Of what value is liver?
17 What direction should be given for its cooking? Why?
18 How much protein should the normal adult diet contain?
19 How many grams should a "high" protein diet contain?
20 How do light and dark fish differ in composition?
21 Name four conditions under which a high protein diet is advantageous
22 What is the nutritive value of milk?
23 How do cheese and milk compare in composition?
24 What is meant by the pasteurization of milk?
25 How should milk be handled in the home?
26 What is the nutritive difference between butter and margarine?
27 How does cooking alter starch?
28 How does the carbohydrate value vary in fruits and vegetables?
29 Do fruits and vegetables differ in nutritive value? Explain
30 What are the symptoms of vitamin A deficiency?
31 What is the "recommended allowance" for ascorbic acid for the normal individual?
32 Is this the same as the "minimum requirement"? Give reason for your answer
33 What is your approximate requirement for thiamine?
34 How might this be met?
35 What is the role of iron in the body?
36 What is the recommended allowance for calcium for a 1 year old child?
37 Is fluid intake important in health? Give reason for your answer

38 How accurately do tables of food composition indicate the nutritive value of foods?
39 What factors influence the nutritive value of vegetables?
40 Do you consider a nutrition history of value? Why?
41 List the Basic Seven food groups and indicate the composition and value of each group
42 Are proteins and carbohydrates incompatible in the diet? Give reason for your answer
43 Of what value are nuts in the diet?
44 Outline a daily dietary pattern for yourself
45 How would you alter this to bring about weight loss?
46 What are the dangers and disadvantages of obesity?
47 How is obesity measured in the individual?
48 How can you approximately determine your desirable weight?
49 How rapidly should weight be lost? Why?
50 Suggest measures whereby you may increase your diet by 1,000 calories daily
51 Could a vegetarian diet be adequate? Explain
52 What adjustments should be made in the diet during pregnancy? Why?
53 Would the diet for pregnancy be adequate for lactation?
54 How would you calculate the formula for a baby weighing 8 pounds?
55 Outline a diet which might be served to a 9 month old baby
56 How does the diet of a 2 year old child differ from that of an adult?
57 Can dental caries be influenced by diet? Give reason for your answer
58 How would the diet of a man 85 years old differ from the diet of one 35?
59 What factors should be considered in planning the diet for an older person?
60 How could the normal diet be modified to become a bland diet?
61 What are the characteristics of a bland diet?
62 Differentiate between a liquid a soft and a regular diet
63 Upon what principle is the diet for the diabetic based?
64 How might the written prescription in terms of grams of P F and C differ for the diabetic and the normal individual if both had a need for 3 000 calories daily?
65 Would the type of insulin used alter the diet pattern? How?
66 What are the characteristics of the diet in celiac disease? If bananas are used why should they be fully ripe?
67 How may hypoglycemia be treated by diet?
68 What restrictions might be made in the diet of the patient with gout?
69 What organ dysfunction is associated with Addison's disease?
70 What types of disorders occur along the gastrointestinal tract?
71 How could these affect the food intake?
72 What specific instructions should be given a gastric ulcer patient?
73 What is the diet currently used for liver disorders?
74 Is a low or high protein diet indicated in albuminuria? Give reason.
75 What are renal calculi?

76 What is meant by the "rice diet"?
77 What are the outstanding features of the low sodium diet?
78 Why is this type of diet sometimes used?
79 How does the low sodium diet differ from the low salt diet?
80 What foods should be emphasized in anemia?
81 What effect does fever have on the need for food?
82 What is meant by a ketogenic diet? How could a diet be altered to bring this about?
83 What foods are frequently associated with allergy?
84 What are elimination diets?
85 What precautions must be taken in planning the diet for allergy?
86 Name three skin disorders which result from food deficiencies?
87 What are the characteristics of pellagra?
88 Is this condition curable? Give reason for your answer
89 What is meant by a subclinical deficiency?
90 How may they be detected?
91 Name three factors that might alter food needs?
92 Are data on the cholesterol content of foods ever of value? Give reason for your answer
93 What factors other than food and physical defects influence health?
94 How would you explain an apparent food deficiency in a person consuming an apparently adequate diet?
95 Do you consider nutrition a "pure science"? Give reason for your answer
96 What precautions must be taken in the cooking of protein food?
97 Suggest a menu which might be tray served to a woman 60 years old who is not acutely ill and has no need for an adjusted diet
98 Outline a diet for a patient who underwent an operation for colostomy a month ago
99 What general directions should be followed in preparing a tray?
100 What knowledge has been gained in this course which can be practically applied to your own life?

PART V

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American Journal of Diseases of Children	Am J Dis Child
American Journal of the Medical Sciences	Am J M Sc
American Journal of Physiology	Am J Physiol
American Journal of Public Health	Am J Pub Health
Annals of Allergy	Ann Allergy
Annals of Internal Medicine	Ann Int Med
Archives of Internal Medicine	Arch Int Med
Archives of Pediatrics	Arch Pediat
Journal of the American Dietetic Association	J Am Dietet A
Journal of the American Medical Association	J A M A
Journal of Biological Chemistry	J Biol Chem
Journal of Clinical Investigation	J Clin Invest
Journal of Clinical Nutrition	J Clin Nutrition
Journal of Dairy Science	J Dairy Sc
Journal of Experimental Education	J Exper Educ
Journal of Experimental Medicine	J Exper Med
Journal of Nutrition	J Nutrition
Journal of Pediatrics	J Pediat
Medical Clinics of North America	M Clin North America
New England Journal of Medicine	New England J Med
Nutrition Reviews	Nutrition Rev
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PART VI

APPENDIX

TABLE 120.—*Approximate* FOOD VALUES FOR GROSS PLANNING OF DIETS

Since the *100 calorie* portion is in general the average serving or a simple fraction or multiple thereof it is possible to list **roughly** foods of equal caloric content in typical food groups. *Within these groups the foods suggested are interchangeable and one selects the food preferred.* Such a list follows:

Cereals (100 cal.)

20 gm. C. 4 gm. P. 1 gm. F.
- Corn flakes 1¼ cups
- Cream of Wheat ⅔ cup
- Grape Nuts 2 tbs.
- Muffets or shredded wheat 1
- Oatmeal cooked ¾ cup
- Puffed wheat or rice 1 cup

Fruits (100 cal.)

20 gm. C. 2 gm. P.
- Apples 1 large
- Apricots dried 8 halves
- Banana 1 small
- Canned cherries ⅔ cup
- Grapefruit ½, 1 cup juice
- Grapes 1 med. bunch
- Orange 1 large, 1 cup juice
- Pear 3 halves
- Peaches 3 halves
- Pineapple 1 slice
- Prunes 3 to 4
- Watermelon large serving

Breads and Crackers (100 cal.)

Breads 20 gm. C. 3 gm. P. 1 gm. F.
Crackers 16 gm. C. 3 gm. P. 3 gm. F.
- White or brown 1 thick slice
- Parker house roll 1
- Saltines 6
- Oyster crackers 36
- Melba toast 2 slices
- Zwieback 3 slices

Potato or Potato Substitute (100 cal.)

20 gm. C. 3 gm. P.
- White potato 1 med.
- Potato chips ⅔ cup
- Sweet potato ½ med.
- Macaroni cooked 1 cup
- Noodles cooked ¾ cup

Vegetables (100 cal.)

20 gm. C. 2 gm. P.
- Baked beans ⅓ cup
- Lima beans ½ cup
- Kidney beans ½ cup
- Peas ¾ cup
- Corn ⅓ cup

Desserts—Variable

Puddings (Spanish cream)	12 gm. P.	7 gm. F.	21 gm. C.
Cakes (butter)	4 gm. P.	8 gm. F.	26 gm. C.
Pie (apple)	3 gm. P.	7 gm. F.	30 gm. C.

(100 cal.)
- Ginger snaps, vanilla wafers, **chocolate** wafers 5
- Macaroons 2 or 3
- Fruits (see above)
- Sugar cookies 1

(200 cal.)
- Pie, small piece
- Puddings average serving
- Fried cakes 1
- Cake average piece
- Ice cream average serving

Vegetables (25 cal.)

5 or less gm. C. 1 gm. P.
- Asparagus 6 stalks
- Cabbage cooked ⅔ cup
- Cauliflower large serving
- Greens ½ cup
- Mushrooms 6
- Sauerkraut ½ cup
- Spinach ½ cup
- Tomato fresh 1 med.
- Tomato canned ¼ cup
- Tomato juice ½ cup
- Turnips ½ cup

Vegetables (50 cal.)

10 gm. C. 1 gm. P.
- Beets diced ½ cup
- Carrots ½ cup
- Onions 2 med.
- Turnips ½ cup

Vegetables (75 cal.)

15 gm. C. 1 gm. P.
- Lima beans, fresh ½ cup
- Corn on cob 2 small ears
- Parsnips ½ cup
- Peas young ½ cup

Meats med. fat (150 cal.)

16 gm. P. 10 gm. F.
- Porterhouse, sirloin, rump average serving
- Pork loin 1 med. chop
- Veal cutlet large serving
- Ham small serving
- Leg of lamb small serving
- Broiler large serving
- Fowl small serving

Meat Substitutes (100 cal.)

American cheese	6 gm. P.	8 gm. F.	
Cottage cheese	18 gm. P.	1 gm. F.	4 gm. C.
Egg	9 gm. P.	7 gm. F.	

- Liver average serving
- Sausage frankfurt 1
- Cottage cheese 5 to 6 tbs.

TABLE 120—CONT'D

Cheese 1¼ in cube
Oysters ⅔ cup
Scallops ¾ cup
Bacon 2 to 3 slices
Sausage pork 1 small
Fish average serving (except salmon, mackerel, whitefish, roe, small serving of these)
Egg 1 to 1½

Beverages (100 cal.)

Whole milk 5 gm P., 6 gm F., 7.4 gm C.
Skim milk 9 gm P., 1 gm F., 14 gm C.
Fruit juice 23 gm. C., 1 gm P.
Milk ⅔ cup
Skim milk, 1⅛ cups
Buttermilk 1⅛ cups
Carbonated drinks 1⅓ cups
Fruit juice 1 cup

Miscellaneous (100 cal.)

Butter 1 tbs
Sugar 5 tsp
Cream (coffee) 4 tbs
Mayonnaise 1 tbs
Jelly 1½ tbs
Cream (whipping) 2 tbs

Candies (100 cal.)

Variable—largely sugars
Caramels 1
Nougats 1½
Chocolate peppermints 1½
Gum drops 3
Marshmallows 4
Fudge 1 in. cube
Milk chocolate ⅓ of 5 cent bar

TABLE 121—FOOD EQUIVALENTS FOR INTERCHANGES IN THE DIET

Foods, when nearly equal in food value, may be substituted for one another in the diet Fruits, vegetables, and cereals are interchanged on the basis of their carbohydrate content, butter, cream, and oils according to their fat content, and meats, cheese, and eggs according to the amounts of protein and fat which they contain

Five per cent vegetables are those which contain approximately 5 gm [illegible] (1 level teaspoonful of sugar weighs [illegible] able will weigh approximately 100 gm [illegible] cup

A 10% vegetable or fresh fruit, or fruit canned without sugar, contains 10 gm carbohydrate per 100 gm Obviously, there is as much carbohydrate in a half cup of a 10% vegetable as in 1 cup of a 5% vegetable

An attempt to classify foods into a few groups sufficiently inclusive to be practical, of course, has disadvantages More sharply defined grouping according to carbohydrate content, by increasing the number of groups, makes for cumbersome detail For example, the 5% group is sometimes further divided into 1, 3 and 5% vegetables, the 10%, into 6, 9 and 12% vegetables etc If one takes into account the differences in composition, age freshness, cooking losses, etc, perhaps this wide grouping should still be used until new data accumulate When more complete analyses are available, reclassification can be undertaken

A classification of vegetables follows

5% and under (may be averaged as 3%)

- Artichokes, French
- Asparagus
- Beet greens
- Broccoli
- Brussels sprouts
- Cabbage
- Cauliflower
- Celery
- Cucumber
- Eggplant
- Endive
- Kohlrabi
- Leeks
- Lettuce
- Mushrooms
- Peppers, green or red
- Radish
- Sauerkraut
- Swiss chard
- Spinach
- Squash, summer
- String beans, very young or canned*
- Tomatoes and tomato juice
- Water cress

10%

- Beets
- Carrots
- Celery roots
- Onions
- Peas very young or canned*
- Pumpkin
- Rutabagas
- Squash winter or Hubbard
- String beans, fresh
- Turnip

15%

- Artichokes, Jerusalem
- Beans, Lima, very young or canned*
- Corn, on cob and young
- Parsnips
- Peas, fresh
- Salsify or vegetable oyster

20%

- Beans baked
  - kidney
  - Lima
  - navy
  - shelled butter
- Corn, canned
- Lentils
- Succotash, canned
- Potato white

Rice, Macaroni, Hominy } may be considered to have same value as 20% vegetable

The vegetables containing 10% [illegible] age, 5% protein

Fruit values are based on products canned without additional sugar

*Liquid discarded—heated in fresh water

Table 121.—Food Equivalents for Interchanges in the Diet

Foods, when nearly equal in food value, may be substituted for one another in the diet Fruits, vegetables, and cereals are interchanged on the basis of their carbohydrate content, butter, cream, and oils according to their fat content, and meats, cheese, and eggs according to the amounts of protein and fat which they contain

Five per cent vegetables are those which contain approximately 5 gm. carbohydrate per 100 gm vegetable (1 level teaspoonful of sugar weighs 5 gm) In general, a serving of vegetable will weigh approximately 100 gm and can be measured roughly as a half cup

A 10% vegetable or fresh fruit, or fruit canned without sugar, contains 10 gm carbohydrate per 100 gm. Obviously, there is as much carbohydrate in a half cup of a 10% vegetable as in 1 cup of a 5% vegetable

An attempt to classify foods into a few groups sufficiently inclusive to be practical, of course, has disadvantages More sharply defined grouping according to carbohydrate content, by increasing the number of groups makes for cumbersome detail For example, the 5% group is sometimes further divided into 1, 3 and 5% vegetables, the 10%, into 6, 9 and 12% vegetables etc If one takes into account the differences in composition age, freshness cooking losses, etc, perhaps this wide grouping should still be used until new data accumulate When more complete analyses are available reclassification can be undertaken

A classification of vegetables follows

5% and under (may be averaged as 3%)

Artichokes, French
Asparagus
Beet greens
Broccoli
Brussels sprouts
Cabbage
Cauliflower
Celery
Cucumber
Eggplant
Endive
Kohlrabi
Leeks
Lettuce
Mushrooms
Peppers, green or red
Radish
Sauerkraut
Swiss chard
Spinach
Squash, summer
String beans, very young or canned*
Tomatoes and tomato juice
Water cress

10%

Beets
Carrots
Celery roots
Onions
Peas very young or canned*
Pumpkin
Rutabagas
Squash winter or Hubbard
String beans, fresh
Turnip

15%

Artichokes, Jerusalem
Beans, Lima, very young or canned*
Corn, on cob and young
Parsnips
Peas, fresh
Salsify or vegetable oyster

20%

Beans, baked
kidney
Lima
navy
shelled butter
Corn, canned
Lentils
Succotash, canned
Potato, white

Rice, Macaroni, Hominy } may be considered to have same value as 20% vegetable

The vegetables containing 10% or less carbohydrate have a protein content of approximately 1%, the 20% group contains, on the average, 3% protein

---

Fruit values are based on products canned without additional sugar

*Liquid discarded—heated in fresh water

TABLE 121—CONT'D

The value for fruits is essentially the same whether the fruit is raw or canned provided the canning is done without sugar. The canning may be as a water pack, or the fruit may be canned in its own juice (juice pack). However, water packed fruits, if the water is discarded, have a somewhat reduced carbohydrate content (approximately 4%), compared with fresh fruit, due to carbohydrate that goes into solution.

The 5% fruits are: avocado, honeydew melon, watermelon, muskmelon, rhubarb, and strawberries.

The 10% fruits are:

Canned	*Fresh*
Applesauce	Blackberries
Apricots	Cranberries
Blackberries	Currants
Blueberries	Grapefruit
Cherries	Lemons
Figs	Loganberries
Fruit salad	Oranges
Grapes, seedless	Peaches
Grapefruit, also juice	Tangerines
Loganberries	
Peaches	
Pears	
Pineapple slices	
Plums	
Raspberries, red or black	

Fruits considered as approximately 15% are as follows:

Apples	Huckleberries
Apricots, fresh	Pears
Blueberries, fresh	Pineapple juice
Cherries, sour	Raspberries, fresh
Grapes	

Fruits considered as approximately 20% are:

Bananas	Grape juice
Cherries, sweet	Prunes and plums, fresh
Figs, fresh	

All dried fruits are over 60% carbohydrate.

TABLE 122

APPROXIMATE PROTEIN VALUES (See Table 138 for Details)

		GM
Bacon	3 slices	2
Breads	1 slice "sliced"	3
Cereal	Average 1 oz servings	
	Oatmeal	4½
	Puffed, flaked, etc	2
	Whole wheat	3
Cheese	Average serving 1½ × 1 × 1 in cube	
	American or Cream	8
	Cottage 2 tbs	6
	Swiss 1 slice	11
Eggs	White	3
	Whole	6
	Yolk	3
Fish—Fowl—Meat	1 oz serving	6
	Average serving 3 4 oz	
Fruits	Average size of ½ c cut up	1
Gelatin	Average serving—½ c	2
Legumes	Average serving—½ c	6 8
Meat	See Fish	
Milk	Fluid buttermilk Skim or whole	
	1 qt	32
	1 c	8
	Dried Malted 1 tbsp	1
	Skim 1 tbsp	3
	Whole 1 tbsp	2
	Evaporated 1 tbsp	1
Oysters	Average serving 5 or 6	6
Peanuts	30 nuts or 2 tbsp butter	8
Potato	White 1 average (5 oz)	3
Vegetables other than legumes or potato		
	Average serving—½ c	1
A few special foods or puddings—1 tbsp each		
	Betene	3
	Casec	2
	Casein (crude edible)	9
	Cocomalt	1½
	Dietene	2½
	Nutramigin	1¾
	Olac	2
	Protein Milk	3
	Soy Flour	6
	Vegex	3½
	Yeast—Dried	6

TABLE 123

APPROXIMATE CALORIE CONTENT OF COMMON FOODS*

Food	*Amount*	*Approximate Calories*
Apple, baked, with sugar	1 large	150
Apple, fresh	1 large	100
Applesauce, sweetened	1 average serving	140
Apricots, canned	1 average serving	100
Apricots, dried, stewed, sweetened	1 average serving	75
Apricots, fresh	1 large	25
Asparagus, canned	1 average serving	15
Asparagus, fresh	1 average serving	15
Avocado pear	½	165
Bacon	1 average serving	85
Banana	1	100
Beans, green, string	1 average serving	30
Beans, Lima, dried, stewed	1 average serving	175
Beans, Lima, fresh	1 average serving	125
Beans, navy, cooked	1 average serving	150
Beef, corned	1 average serving	125
Beef, dried, creamed	1 average serving	250
Beef, Hamburg	1 cake	125
Beef, meat loaf	1 average serving	150 200
Beef, pot roast (lean)	1 average serving	200
Beef, round (lean)	1 average serving	150 200
Beef, sirloin, roast (lean)	1 average serving	150
Beef vegetable stew	1 average serving	250
Beet greens	1 average serving	30
Beets	1 average serving	40
Biscuit, baking powder	1 medium	75
Blackberries, fresh	1 average serving	75
Blueberries, fresh	1 average serving	75
Bluefish	1 average serving	125
Bologna sausage	1 average serving	120
Bread, corn	1 slice	150 200
Bread, enriched, 100% whole wheat, rye, etc.	1 slice	65 75
Bread, raisin	1 slice	85 100
Broccoli	1 average serving	30
Brussels sprouts	1 average serving	50
Butter	1 average pat	100
Buttermilk	1 glass	90
Cabbage, cooked	1 average serving	50
Cabbage, raw, shredded	1 average serving	20
Cake, angel food	1 average serving	125 150
Cake, frosted	1 average serving	150 175
Cake, layer, frosted and filled	1 average serving	400 450
Cake, plain	1 average serving	100 125
Cake, sponge	1 average serving	125 150
Candy	1 piece	50 100
Cantaloupe	½	60
Carrots, cooked	1 average serving	50
Cauliflower	1 average serving	20

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Food	*Amount*	*Approximate Calories*
Celery	2 stalks	10
Cereal, cooked	1 average serving	100
Cereal, ready to serve	1 average serving	50 100
Chard, Swiss	1 average serving	45
Cheese, American, Gruyère, Swiss	1 average serving	100 125
Cheese, cottage	1 generous serving	85
Cheese, cream	1 small serving	80
Cherries, canned	1 average serving	100 150
Cherries, fresh	1 average serving	75
Chicken, roast	1 average serving	200
Clams, round	1 average serving	80 100
Cod steak	1 average serving	125
Collards	1 average serving	65
Cookies, plain	1	50
Corn, canned	1 average serving	150
Corn, fresh	1 average serving	150
Crab meat, canned	1 average serving	70
Crackers, butter or saltines	1	15
Cranberry sauce, canned	1 average serving	75
Cream, heavy	2 tablespoons	125
Cream, coffee	2 tablespoons	50
Cucumber	1 average serving	10
Custard, baked or "boiled"	1 average serving	125
Dandelion greens	1 average serving	40
Dates, pitted	1	20 25
Eggs	1	70-75
Escarole	1 average serving	25
Fish cakes	2	200 250
Frankfurter	1 medium	100
Gelatin, fruited	1 average serving	100 125
Gingerbread	1 average serving	200
Grapefruit	½ medium	100
Grapefruit juice	¾ cup	75
Grapefruit sections	1 average serving	65
Grapejuice	¾ cup	130
Grapes, Concord	1 medium bunch	80
Gravy, brown	1 tablespoon	20 25
Halibut	1 average serving	175
Ham cooked	1 average serving	250 300
Hash, beef	1 average serving	350
Honey	1 average serving	50
Honeydew melon	2 tablespoons	200
Ice cream, commercial	1 average serving	200 250
Ice, fruit	1 average serving	150 175
Jams, jellies	1 average serving	100
Kale	1 average serving	40
Kidney	1 average serving	150
Lamb (lean)	1 average serving	150 200
Lamb stew	1 average serving	400
Lentils	1 average serving	150
Lettuce	1 average serving	20
Liver	1 average serving	200
Liverwurst sausage	1 average serving	100 150
Lobster meat	1 average serving	100
Loganberries	1 average serving	75
Macaroni	1 average serving	135

Food	Amount	Approximate Calories
Mackerel	1 average serving	125 150
Margarine	1 average pat	100
Milk, condensed, sweetened	1 tablespoon	65
Milk evaporated	¼ cup	90
Milk, skimmed	1 glass	90
Milk, whole	1 glass	170
Muffins	1 medium	100 150
Mustard greens	1 average serving	30
Noodles	1 average serving	135
Oatmeal	1 average serving	90 100
Okra	1 average serving	30
Onions	1 medium	30 35
Orange juice	1 cup	130 140
Oranges, whole	1	80 100
Oysters	1 average serving	100 120
Parsnips	1 average serving	65
Peaches canned	1 average serving	90 100
Peaches, fresh	1	50 60
Peanut butter	2 tablespoons	200 225
Pears, canned	1 average serving	50
Pears, fresh	1	50 60
Peas, canned, drained	1 average serving	65
Peas, fresh	1 average serving	85
Peppers, green	1 large	25
Persimmon	1	100
Pie, apple	1 average wedge	250
Pie, blueberry	1 average wedge	275
Pie, cherry	1 average wedge	375
Pie, custard	1 average wedge	250
Pie, lemon meringue	1 average wedge	350
Pie, mince	1 average wedge	350
Pie, pumpkin	1 average wedge	300
Pie, rhubarb	1 average wedge	275
Pineapple, canned	1 average serving	75
Pineapple, fresh	1 average serving	65
Pineapple juice, canned	1 glass	150
Plums, fresh	1	25 30
Pork, cooked	1 average serving	150 200
Potatoes, French fried	1 average serving	125
Potatoes, mashed	1 average serving	125
Potatoes, sweet	1	200 225
Potatoes, sweet, candied	1 average serving	300
Potatoes, white, baked, or boiled	1	100
Prunes, dried stewed, sweetened	1 average serving	125
Pudding, bread	1 average serving	250 300
Pudding, cornstarch	1 average serving	200
Pudding rice	1 average serving	125 150
Radishes	1 average serving	10 12
Raisins	1 tablespoon	40 45
Raspberries, fresh	1 average serving	65
Rhubarb, stewed, sweetened	1 average serving	125
Rice, brown or white	1 average serving	100 125
Rolls, Parker House	1	100
Rutabagas	1 average serving	75

Food	Amount	Approximate Calories
Salad dressing	1 average serving	
Boiled	1 average serving	50
French	1 average serving	150
Mayonnaise	1 average serving	150
Russian	1 average serving	125
Salmon, canned or fresh	1 average serving	100 150
Sandwich	1	250 300
Sardines canned	1 average serving	75 100
Sausage, pork	1	60
Scallops, fried	1 average serving	250
Shad roe	1 average serving	200
Sherbet, fruit	1 average serving	175 200
Soda, bottled	1 average serving	65 75
Soda ice-cream	1 average serving	300 350
Soup bouillon or consommé	1 average serving	20
Soup, cream of vegetable	1 average serving	175 200
Soup, tomato, clear	1 average serving	75
Soup vegetable	1 average serving	80 100
Soybeans, yellow, dried	1 tablespoon	50
Spinach	1 average serving	30
Squash, Hubbard	1 average serving	60
Squash summer	1 average serving	30
Strawberries, fresh	1 average serving	60
Succotash	1 average serving	175
Sugar, brown	1 tablespoon	35
Sugar, granulated	1 teaspoon	17
Sundae	1	350-500
Tangarine	1	40 50
Tapioca cream	1 average serving	125
Tomato juice	½ cup	30
Tomatoes, canned	1 average serving	40
Tomatoes, fresh	1	30 40
Tongue	1 average serving	125
Tuna fish	1 average serving	150
Turkey	1 average serving	300
Turnip greens	1 average serving	45
Turnips, white	1 average serving	35
Veal, cooked	1 average serving	200
Water cress	1 average serving	5
Watermelon	1 average serving	100 125

Inasmuch as the calculation of the sodium value of the diet is practiced so frequently at the present time, the following detailed table is offered

Sodium and Potassium Analyses of Foods and Waters From the Research Laboratory of Mead Johnson & Company, 1947

Foreword

Previously available tables giving the sodium content of foods and public water supplies have always been compiled from data obtained by the conventional methods of chemical analysis It is well known that in most of these methods traces of potassium tend to be weighed as sodium so that when the amount of sodium is small an appreciable error is introduced, which may be relatively large as the quantity of sodium approaches zero The following data were obtained by flame photometry and are believed to represent a new order of accuracy in figures for sodium

In spite of the character of the individual analyses it must be kept in mind that the figures represent only single samples or at most a few samples of the material examined For this reason the findings are reported in no more than two significant figures and only in one significant figure when the content is less than 10 mg per 100 grams The individual samples were analyzed in duplicate Emphasis was given to unprocessed or slightly processed foods rather than to culinary creations in which the use of salt and other sodium compounds is highly variable Brand names of manufactured products are given only when their use is unavoidable but in general leading brands are represented

It will be noted that natural foods usually contain less sodium than those which have been processed For example fresh peas are almost sodium free but canned frozen and dry split peas contain large amounts of added sodium Sodium compounds are so widely used in processing foods, and their use in most circumstances is so harmless that the pure food laws do not require label declarations in many instances Foods labeled as containing salt should of course be avoided in low sodium diets, but the absence of such label statements is no guarantee that large amounts of sodium are not present

As a rule fresh foods of vegetable origin contain little sodium, while foods of animal origin contain much sodium even when none is added Thus the protein sources having the highest biological value are also the high sodium foods—meat, eggs and milk The low sodium product Lonalac was specially designed to provide a protein food of animal origin suitable for liberal use in low sodium diets

Values for potassium are included for the benefit of research workers interested in the role of this element Information on many foods not listed is available on request Physicians should bear in mind that the listing of any given food as of low sodium content does not imply that such food is in every other respect a suitable one for all patients Attention is called to the listing of public water supplies at the end of these tables, because drinking water in some communities is a significant source of dietary sodium

Table 124

Food*	Na, mg per 100 gm	K, mg per 100 gm
Allspice, ground	62	680
Almond	2	690
Almond, roasted in oil and salted	160	710
Anchovy paste	12,000	1,900
Apple juice (sweet cider), bottled	4	100
Apple, less skin	0.1	68
Applesauce, canned	0.3	55
Apricot	0.5	440
Apricot, canned in sirup	2	65
Asparagus, spears, canned	400	130
Asparagus, tips	2	240
Asparagus, tips, frozen	3	320
Avocado	2	340
Bacon	760	95
Bacon, fried crisp	3,200	450
Banana	0.1	400
Barley, pearled	3	160
Bean, Great Northern, dry	0.3	1,400
Bean, green	0.8	300
Bean, green, canned	*410*	*120*
Bean, green, frozen	2	110
Bean, Lima	1	680
Bean, Lima, canned	310	210
Bean, navy, dry	0.9	1,300
Beef, corned	1,700	400
Beef, dried	3,900	1,000
Beef, less excess fat	53	380
Beer	8	46
Beet	110	350
Beet, canned	36	120
Beet leaves	130	570
Blackberry	0.2	150
Blueberry	0.5	89
Bouillón cube	27,000	1,500
Brain, pig	150	340
Brandy	3	4
Brazil nut	0.8	650
Brazil nut, roasted in oil and salted	190	730
Bread, low sodium, (made with Lonalac)	2	120
Bread, low sodium, cinnamon roll	2	120
Bread, Passover. See matzoth	---	-----
Bread, rye and wheat	560	100
Bread, semi whole wheat	670	300
Bread, wheat, white	670	130
Bread, whole wheat	930	210
Broccoli	16	400
Brussels sprouts	11	450
Brussels sprouts, frozen	9	300
Butter, average salted. Theoretical value based on U.S. average salt content of 2.5%	980	------
Butter, lightly salted	780	16
Butter, unsalted	5	4
Buttermilk, cultured	130	140
Cabbage	5	230
Cantaloupe	12	230
Caraway seed	16	1,400
Carrot	31	410
Carrot, canned	280	110
Cashew nut	13	560
Cashew nut, roasted in oil and salted	200	560
Catchup, tomato	1,300	800
Catfish (fiddler)	60	330
Cauliflower, bud	24	400
Cauliflower, bud, *frozen*	22	*290*
Caviar, salmon	2,200	640
Celery salt	26,000	3,100
Celery, seed	140	1,400
Celery, stalks	110	300
Cereal, bran	1,400	1,200
Cereal, wheat, Instant Ralston	1	360
Cereal, wheat, Maltex	4	250
Cereal, wheat, Pettijohn's	2	380
Cereal, wheat, Wheatena	1	380
Cheese, American Swiss	420	110
Cheese, cheddar	540	130
Cheese, cottage	320	80
Cheese, cream	340	90
Cheese, process	1,500	440
Cheese, whey (cheese food)	1,500	520
Cherry, dark sweet	1	260
Cherry, dark sweet, canned in sirup	0.7	77
Cherry, dark sweet, frozen in sirup	1	280
Cherry, light sweet, canned in sirup	3	55
Chestnut	2	410
Chicken, breast meat	78	320

*Edible portions only. Fresh uncooked material unless otherwise described.

TABLE 124—CONT'D

FOOD	Na, MG PER 100 GM	K, MG PER 100 GM
Chicken, leg meat	110	250
Chocolate, milk	86	420
Chocolate sirup	60	130
Chocolate, unsweetened	4	830
Cider, sweet (apple juice)	4	100
Cinnamon, ground	6	200
Citron, candied	290	70
Clam	180	240
Coca Cola (soft drink)	1	52
Cocoa, powder, Dutch process	55	3,200
Cocoa, powder, ordinary, Hershey	4	1,400
Coconut, dry, shredded	16	770
Cod	70	360
Cod, frozen fillets	100	400
Cod liver oil	0.1	0
Cod, salted	7,200	80
Coffee, roasted	2	1,600
Corn flakes	660	160
Corn meal, yellow, enriched	0.6	120
Corn oil	0.2	0.1
Corn, popcorn, popped and oiled	3	320
Corn, popcorn, popped, oiled and salted	1,500	340
Corn starch	4	4
Corn, sweet white, canned	200	200
Corn sweet white, milk stage	0.2	240
Corn, sweet yellow, canned	210	200
Corn, sweet yellow, frozen	9	190
Corn sweet yellow, milk stage	0.3	370
Corn, yellow, 5 varieties, dry	0.4	290
Cowpea	1	560
Crab, canned	1,000	72
Cracker, Graham	700	440
Cracker, soda	1,500	500
Cranberry	1	65
Cranberry sauce, canned	1	17
Cream whipping (32% fat)	40	56
Cucumber, less parings	0.8	230
Currant	2	160
Currant, Zante, dried (Zante raisins)	22	730
Curry powder	45	1,300
Dandelion	76	430
Date, semi dry	0.9	790
Dextrin	14	14
Dextrose	1	0.4
Dill, seed	12	1,000
Duck, domesticated, breast meat	68	360
Duck, domesticated, leg meat	96	210
Egg	140	130
Egg, whites only	200	140
Egg, yolks only	34	85
Eggplant	0.8	190
Endive	18	400
Farina	0.8	88
Farina, quick cooking enriched	100	95
Fig	2	190
Fig, canned in sirup	1	110
Fig, dried	33	780
Filbert	0.8	560
Flour, bleached, enriched, Gold Medal	1	86
Flour bleached, enriched phosphated	13	78
Flour, buckwheat	1	680
Flour, gluten	2	24
Flour, rye, dark	1	860
Flour, white, natural	1	120
Fruit cocktail, canned in sirup	9	160
Garlic	6	510
Gelatin dessert, dry	330	210
Gelatin, plain, dry	27	11
Gin	0.7	0.3
Ginger ale	8	0.6
Ginger, ground	29	1,100
Gizzard, turkey	58	170
Gluten, wheat	2	21
Gooseberry	0.6	87
Grape juice, Concord, sweetened, bottled	1	120
Grape, Thompson Seedless	4	180
Grapefruit	0.4	200
Grapefruit juice, sweetened, canned	0.4	150
Gravy flavoring	86	280
Halibut	56	540
Ham, less excess fat	2,100	610

TABLE 124—CONT'D

FOOD	Na, MG PER 100 GM	K, MG PER 100 GM
Hash, corned beef, canned	880	380
Heart, beef	90	160
Heart, turkey	69	240
Hominy, canned	180	50
Honey	7	10
Horseradish, prepared	96	290
Ice cream, vanilla	100	90
Jam, grape	7	78
Kale	110	410
Kidney, beef	210	310
Lamb, less excess fat	110	340
Lard	0.3	0.2
Lemon, less rind	0.6	130
Lettuce, head	12	140
Litchi, dried	3	1,100
Liver, calf	110	380
Liver, pig	77	350
Liver, turkey	51	160
Lobster, boiled in tap water	210	180
Lonalac	20	1,200
Lonalac, reliquefied	2	160
Macaroni	1	160
Mace, ground	45	180
Maize See corn	------	------
Maple sirup	14	130
Marmalade, orange	13	19
Matzoth, American style	360	130
Matzoth, egg	16	160
Matzoth farfel	28	130
Matzoth meal	4	125
Matzoth, Passover	1	140
Matzoth, plain	1	140
Matzoth, poppy seed	350	140
Matzoth, tasty wafer	430	260
Matzoth, thin tea	2	130
Matzoth, whole wheat	280	420
Mayonnaise	600	17
Milk, buttermilk, cultured	130	140
Milk, dialyzed Replaced by Lonalac	------	------
Milk, evaporated	100	270
Milk, goat	34	180
Milk, human, from 9 mothers, 3 to 10 days postpartum	40	64
Milk, human, from 4 mothers, 49 to 77 days postpartum	11	51
Milk, malted	440	720
Milk, whole, dry	410	1,100
Milk, whole, liquid	51	140
Molasses, cane	80	1,500
Mulberry	0.6	200
Mushroom	5	520
Mushroom, canned	470	260
Mustard greens	48	450
Mustard, powder	3	840
Mustard, prepared paste	1,100	280
Nutmeg, ground	14	160
Oats, rolled	2	340
Okra, pods	1	220
Oleomargarine	1,200	230
Olive, green pickled	2,200	290
Olive oil	0.2	0.2
Olive, ripe pickled	920	240
Onion, white	1	130
Orange	0.2	170
Orange Crush (soft drink)	2	100
Orange juice, unsweetened, canned	0.4	190
Oyster, fresh	73	110
Pancreas, pig	57	240
Paprika, powder	82	2,300
Parsley	28	880
Parsnips	7	740
Pea	0.9	380
Pea, canned, less liquor	230	180
Pea, dry split	42	880
Pea, frozen	100	160
Peach	0.1	180
Peach, canned in sirup	6	31
Peach, frozen in sirup	3	120
Peanut butter	120	820
Peanut oil	0.2	0.1
Peanut, roasted in oil and salted	460	700
Peanut, roasted in shell	0.8	740
Pear, Bartlett	2	100
Pear, canned in sirup	8	52
Pecan	0.2	420
Pepper, black, ground (spice)	16	880
Pepper, green (vegetable)	0.5	170
Pepper, red, ground (spice)	46	2,400
Pepper, white, ground (spice)	5	48
Persimmon, wild	0.8	340
Pickle, dill	2,300	330
Pilchard See sardine	------	------

TABLE 124—CONT'D

FOOD	Na, MG PER 100 GM	K, MG PER 100 GM
Pineapple	0.3	210
Pineapple, canned in sirup	1	120
Pineapple, frozen in sirup	1	38
Pineapple juice, unsweetened, canned	0.4	140
Plum	0.1	140
Plum, canned	18	110
Pomegranate, juice and pulp	0.3	200
Popcorn, popped and oiled	3	320
Popcorn, popped, oiled and salted	1,500	340
Pork, less excess fat	58	260
Pork, salt	2,900	260
Postum (cereal beverage), dry	36	1,300
Postum, instant, dry	71	2,200
Potato chips	340	880
Potato, sweet, canned	48	200
Potato, sweet, less skin	4	530
Potato, white, canned	350	240
Potato, white, less skin	0.6	410
Poultry seasoning	26	840
Pretzel	1,100	330
Prune, canned in sirup	3	220
Prune, dried	5	600
Prune juice, unsweetened	2	260
Pumpkin	0.4	480
Pumpkin, canned	2	240
Quail, breast meat	35	160
Quail, leg meat	44	190
Quince	0.6	290
Rabbit, domesticated, foreleg	47	370
Rabbit, domesticated, loin	34	400
Radish, with skin	8	260
Raisin, seedless	21	720
Raisin, Zante	22	730
Raspberry, black	0.2	190
Raspberry, oriental (wineberry)	0.8	170
Raspberry, red	0.4	160
Rhubarb, stalks	1	70
Rice flakes	720	180
Rice, puffed	0.8	100
Rice, polished and coated	2	130
Rice, vitaminized	4	170
Rum	2	3
Sage	19	670
Salmon	48	410
Salmon, canned	470	330
Salt, common. Theoretical value for pure NaCl	39,342	0
Sardine (herring), canned in oil	510	560
Sardine (pilchard), canned in natural sauce	760	260
Sardine (pilchard), canned in tomato sauce	400	320
Sauerkraut, canned	730	490
Sausage, Bologna	220	84
Sausage, Frankfurt	1,100	330
Sausage, pork	1,100	440
Shortening, vegetable, Crisco	4	0
Shortening, vegetable, Spry	0.4	0.2
Shrimp	140	220
Sirup, chocolate	60	130
Sirup, maple	14	130
Sirup, sorghum	20	600
Sirup, table (corn and cane)	83	24
Soda, baking. Theoretical value for pure $NaHCO_3$	27,373	0
Sorghum sirup	20	600
Soup, beef, canned. Diluted as served	400	244
Soup, tomato, canned. Diluted as served	400	440
Soup, vegetable, canned. Diluted as served	150	170
Soybean, dry	4	1,900
Soy flour, solvent extracted	0.6	1,700
Spaghetti. See Macaroni	------	------
Spinach	190	790
Spinach, canned	300	260
Spinach, frozen	60	330
Squash, acorn	0.3	260
Squash, Hubbard	0.2	240
Squash, yellow summer	0.5	200
Squash, white summer	0.2	150
Starch, corn	4	4
Strawberry	0.7	180

TABLE 124—CONT'D

FOOD	Na, MG PER 100 GM	K, MG PER 100 GM	FOOD	Na, MG PER 100 GM	K, MG PER 100 GM
Strawberry, frozen, sweetened	2	180	Veal, less excess fat	18	330
Sugar, light brown	24	230	Vinegar, cider	1	100
Sugar, white	0 3	0 5	Vinegar, distilled	0 6	15
Tangerine	2	110	Walnut, black	2	460
Tangerine, juice sweetened, canned	0 6	170	Walnut, English	2	450
Tapioca, granules	5	19	Water, carbonated, I	18	0 6
Tea, India Ceylon Java blend	4	1,800	Water, carbonated, II	1	0 6
Thyme, whole	36	500	Watermelon	0 3	110
Tobacco, chewing	1,600	1,800	Wheat flakes	1,000	540
Tomato	3	230	Wheat germ, containing some bran and flour	2	780
Tomato, canned	18	130	Wheat gluten	2	24
Tomato juice, canned	230	230	Wheat, puffed	3	340
Tongue, beef	100	260	Wheat, shredded	2	340
Tripe, pickled	46	19	Wheat, winter	2	430
Tuna, canned	540	480	Whisky, blended	0 3	1
Turkey, breast meat	40	320	Whisky, bonded	0 1	0 6
Turkey, leg meat	92	310	Wine, port	4	75
Turmeric	21	2,700	Wine, sauterne	10	87
Turnip, leaves	10	440	Wineberry	0 8	170
Turnip, white	37	230	Worcestershire sauce	1,400	360
Turnip, yellow (rutabaga)	5	260	Yeast, compressed	4	360
Vanilla extract	1	74	Yeast, debittered, dry	180	1,900
			Yeast, primary cultured, dry	8 to 320	2,000
			Zwieback	250	170

See also discussion by Bills et al J Am Dietet A 25 304 1949

TABLE 124 A

MEAD JOHNSON & CO PRODUCTS

	Na, MG PER 100 GM	K, MG PER 100 GM		Na, MG PER 100 GM	K, MG PER 100 GM
Alacta (half skim milk), dry	520	1,400	Lactic Acid Milk No 2, dry	400	1,100
Amigen, dry	1,600	270	Lonalac, dry	20	1,200
Amigen 5% in 5% Dextrose Solution	150	29	Lonalac, reliquefied	2	160
Amigen, 10% Solution	240	68	Nutramigen, dry	380	960
Casec (calcium caseinate)	42	21	Olac, dry	270	680
Dextri Maltose No 1	830	220	Pabena, dry	650	500
Dextri Maltose No 2	44	160	Pablum, dry	670	360
Dextri Maltose No 3	45	1,300	Pectin Agar in Dextri Maltose	750	200
Dextri Maltose with Yeast Extract and Iron	52	360	Protein Milk, dry	460	650
Lactic Acid Milk Half Skim, dry	440	1,300	Protenum, dry	360	1,100
			Protolysate, dry	1,500	400
			Sobee, dry	430	1,300
			Yeast, brewer's	8 to 320	2 000

Public Water Supplies

Inasmuch as the sodium content of water may be appreciable, it becomes advisable to check the value when sodium restriction is produced

food and
d odium per
l ne, and a
d e rule to
use only distilled or de ionized water for sodium restricted patients wherever the municipal supply contains more than 3 mg of sodium per 100 c c

Fortunately, the municipal water supplies of many cities are so low in sodium that they are entirely suitable for use in low sodium diets There are, however, some outstanding exceptions Hardness or softness has no bearing on the sodium content of water, except that when hard water is softened by base exchange apparatus the calcium and magnesium are replaced by sodium in the ratio of 2 atoms of sodium for each atom of calcium or magnesium Therefore, water which has been softened is always suspected as regards its suitability for low sodium diets and for the preparation of reliquefied Lonalac

The following table gives the sodium (and potassium) content of the waters of representative cities Included are the principal cities of the United States, the capitals of the states and many places important as medical centers The samples were mostly taken in the winter and spring of 1947, and the analyses were made with the flame photometer Seasonal variations are known to occur, especially in river waters, but river waters rarely contain much sodium

Additional data on public water supplies can be obtained from the various state and municipal laboratories, and from a United States Government bulletin compiled some years ago "The Industrial Utility of the Public Water Supplies in the United States, 1932" (Geological Survey, United States Department of the Interior, Water Supply Paper 658, Washington, D C, Government Printing Office, 1934, order from Superintendent of Documents, 25 cents)

TABLE 124 B

PLACE	Na, MG PER 100 C C	K MG PER 100 C C	PLACE	Na, MG PER 100 C C	K, MG PER 100 C C
Aberdeen, S D	20	2	Buffalo, N Y	0 7	0 3
Albany, N Y	0 2	0 2	Burlington, Vt	0 2	0 1
Albuquerque, N M	5	0 7	Carson City Nev	0 4	0 3
Annapolis, Md	0 2	0 2	Charleston, S C	1	0 3
Ann Arbor, Mich	2	0 5	Charleston, W Va	0 3	0 2
Atlanta, Ga	0 2	0 2	Charlotte, N C	0 3	0 1
Augusta, Maine	0 2	0 2	Charlottesville, Va	0 2	0 1
Austin, Texas	3	0 5	Cheyenne, Wyo	0 3	0 2
Baltimore, Md	0 3	0 2	Chicago, Ill	0 3	0 1
Bangor, Maine	0 2	0 1	Cincinnati, Ohio	0 7	0 3
Baton Rouge, La	9	0 2	Cleveland, Ohio	1	0 3
Beloit, Wis	0 5	0 2	Columbia, S C	0 4	0 2
Biloxi, Miss	23	0 6	Columbus Ohio	5	0 6
Birmingham Ala	2	0 3	Concord N H	0 2	0 1
Bismarck, N D	6	0 6	Crandall Texas	170*	0 5
Boise, Idaho	2	0 3	Dallas, Texas	3	0 5
Boston, Mass	0 3	0 2	Denver, Colo	3	0 2
Brownsville Texas	6	0 3	Des Moines, Iowa	1	0 4

* An extreme example This water is rarely drunk but is used for cooking

TABLE 124 B—CONT'D

PLACE	Na, MG PER 100 CC	K, MG PER 100 CC	PLACE	Na, MG PER 100 CC	K, MG PER 100 CC
Detroit, Mich	0.3	0.1	Nashville, Tenn	0.3	0.2
Dover, Del	2	0.5	Nevada, Mo	33	0.7
Durham, N C	0.4	0.2	Newark, N J	0.2	0.1
El Paso, Texas	7	0.6	New Haven, Conn	0.3	0.1
Ephrata, Pa	0.3	0.2	New Orleans, La	1	0.4
Evansville, Ind	2	0.5	New York, N Y	0.3	0.2
Fargo, N D	5	0.7	Oakland, Calif	0.3	0.1
Frankfort, Ky	0.3	0.1	Oklahoma City, Okla	10	0.8
Galesburg, Ill	30	2	Olympia, Wash	0.5	0.3
Galveston Texas	34	0.7	Omaha, Neb	8	1
Harrisburg, Pa	0.2	0.1	Philadelphia Pa	2	0.4
Hartford, Conn	0.2	0.1	Phoenix, Ariz	11	0.7
Helena, Mont	0.3	0.2	Pierre, S D	9	0.5
Houston, Texas	16	0.6	Pittsburgh, Pa	6	0.5
Huntington, W Va	3	0.2	Portland, Maine	0.2	0.1
Indianapolis, Ind	1	0.3	Portland, Ore	0.1	0.1
Iowa City, Iowa	0.5	0.3	Providence, R I	0.2	0.1
Jackson, Miss	0.4	0.2	Raleigh, N C	0.4	0.1
Jacksonville Fla	1	0.2	Reno, Nev	0.5	0.1
Jefferson City, Mo	3	0.4	Richmond, Va	0.7	0.2
Jersey City, N J	0.3	0.2	Rochester, Minn	0.7	0.2
Kansas City, Kan	4	0.4	Rochester, N Y	0.3	0.2
Kansas City, Mo	10	3	Sacramento, Calif	0.3	0.2
Lansing, Mich	1	0.5	Santa Fe, N M	0.4	0.1
Lincoln, Neb	3	0.7	St Louis, Mo	5	0.5
Little Rock, Ark	0.1	0.1	St Paul, Minn	0.5	0.3
Los Angeles, Calif			Salem, Ore	0.2	0.1
Aqueduct source	6	0.6	Salt Lake City, Utah	0.8	0.2
Metropolitan source	17	0.6	San Diego, Calif	5	0.5
River source	5	0.5	San Francisco, Calif	1	0.3
Louisville, Ky	2	0.3	Seattle, Wash	0.2	0.1
Madison, Wis	0.4	0.2	Sioux Falls, S D	1	0.4
Manchester, N H	0.2	0.1	Springfield, Ill	0.8	0.3
Marion, Ohio	17	0.7	Syracuse, N Y	0.2	0.1
Memphis Tenn	2	0.3	Tallahassee, Fla	0.3	0.1
Miami, Fla	2	0.3	Topeka, Kan	1	0.5
Milwaukee, Wis	0.3	0.1	Trenton, N J	0.1	0.1
Minneapolis, Minn	0.5	0.3	Tucson, Ariz	3	0.3
Minot, N D	25	0.6	Washington, D C	0.3	0.3
Montgomery, Ala	0.8	0.1	Wichita, Kan	5	0.5
Montpelier, Vt	0.1	0.1	Wilmington Del	0.8	0.1

TABLE 12[illegible]

SODIUM CHLORIDE CONTENT OF FOOD

Salt (differentiated from sodium) adjustment is necessary in several conditions, and while the sodium chloride content, and the content of any other mineral of a food varies with the variety, mode of preparation and environmental conditions under which grown, it is possible to approximate the content of the natural food

All corned, pickled, smoked, and salted foods have a high sodium chloride content

Bananas, bread, butter, crackers, egg white, meat stock, meat broth, meat extracts, cheese and milk, molasses, and oysters are rich sources of sodium chloride

Cereals, fruits, and vegetables, in general, are poor sources

For sodium content of foods see Table 124

Approximate values are given for some common foods

KIND OF FOOD	GM NaCl PER 100 GM NATURAL FOOD
Cereals and Cereal Products	
Barley	0 04
Bread, white	0 70 1 0
Corn	0 30
Macaroni	0 7 1 04
Oats, rolled	0 10 0 35
Rice	0 04
Rye	0 015
Dairy Products	
Butter, salted	1 0 3 0
Cheese	1 0 5 0
Egg, yolk	0 04
Egg, white	0 31
Milk	0 18 0 25
Fish	
Cod, fresh	0 16
Cod, salt	3 4
Haddock	0 39
Pickerel	0 10
Salmon	0 12
Fruits	
Apricots	0 005
Grapes	0 025
Pineapple	0 07
Plums	0 005
Raisins	0 16
Strawberries	0 19
Watermelon	0 01
Meats	
Bacon	1 0
Beef	0 11
Chicken	0 14
Goose	0 20
Liver, calf	0 14
Mutton	0 17
Pork	0 10
Veal	0 13

TABLE 125—CONT D

KIND OF FOOD	GM NaCl PER 100 GM NATURAL FOOD
Miscellaneous, prepared in the usual way	
Beef broth	0 73
Chicken soup	0.50
Pea soup	0 35
Soup stock	0 76
Vegetables	
Asparagus, fresh	0 04 0 06
Asparagus, canned	0 83
Beans, fresh	0 09
Beans, canned	0 77
Cabbage, fresh	0 03 0 75
Cauliflower	0 05 0 15
Celery	0 2 0 5
Lettuce	0 1
Onion	0 02 0 30
Peas, fresh	0 06
Peas, canned	0 67
Potato	0 10 0 15
Tomato	0 10

TABLE 126

FOODS CONTAINING OXALIC ACID*

Beet greens	Purslane
Gooseberries	Rhubarb
Lamb's quarters	Spinach
Poke	Swiss chard
Poppy seed	

*Kohman Oxalic Acid in Foods J Nutrition 18 233 1939

TABLE 127

LIST OF A FEW FOODS AND THE POSSIBLE ALLERGENS THEY CONTAIN*

Baby Foods

Borden s Malted Milk Barley, malt wheat flour, whole milk
Carnick s Soluble Food Malted wheat, dried milk, milk sugar
Dryco Rice "polish," vitamin B, irradiated milk
Farina Wheat
Horlick s Malted Milk Barley, wheat flour, desiccated milk, malt, karo syrup (corn syrup)
Mellins' Food Wheat flour, wheat bran, malted barley
Moore's Food Wheat, malt
Nestle's Food Malted whole wheat malt, dry milk, wheat flour, cod liver oil
Pablum Wheat meal, oatmeal, corn meal, yeast, beef bone, iron, salt
Similac Butter fat, olive oil, cocoanut oil, cod liver oil

*Alexander Harry L Synopsis of Allergy St Louis 1941 The C V Mosby Company

Beverages (Nonalcoholic)

Coca Cola Ceffein caramel essential oils (cinnamon, coriander, lemon, neroli, nutmeg, sweet orange) glycerin, lime juice, phosphoric acid coca leaves or kola nuts
Ginger Ale Ginger, lemon sometimes capsicum
Root Beer Caramel oils of anise, birch, cassia cloves, lemon, sassafras, wintergreen coumarin, and vanilla
Sarsaparilla Caramel, cologne spirits, oils of anise, orange, sassafras wintergreen, powdered pumice stone

Beverages (Alcoholic)

Beer (Ale, Stout, Porter) Fermented malted grain, usually barley, wheat, rye oats, rice, and corn may be used Hops are usually added
Brandy Grapes peaches cherries apples, and other fruits
Gin Barley, malt rye and corn, flavored with juniper berries, angelica root, calamus cardamon, cassia, cinnamon, coriander, fennel, grains of paradise licorice, orris root
Whiskey Malt, corn, rye, and other cereals
Wines Usually grapes other fruits

Breads

Glazed crusts contain white of egg
Buckwheat flour is used on the bottom of all breads to prevent burning
Buckwheat Bread Buckwheat, wheat, yeast
Kommisbrot Rye
Pumpernickel Rye graham flour (20%) bleached clear flour (80%), malt (0 1%)
Rye Bread Rye flour (25%) bleached clear flour (75%) yeast
Schwarzbrot Coarse rye flour
White Bread Bleached patent flour yeast, malt, eggs, vegetable oil, butter
Whole Wheat Bread Bleached patent flour whole wheat flour, eggs, caramel
Corn Flakes Corn malt
Cream of Wheat Entirely wheat
Farina Wheat
Grape Nuts Wheat malted barley yeast
Macaroni Wheat milk
New Pettijohn's Wheat
Nutro Wheat peanut flour
Post Toasties Corn
Postum Cereal Wheat bran molasses
Post's Bran Wheat bran malt syrup
Quaker Crackles Corn wheat oats
Ralston's Health Breakfast Food Wheat
Roman Meal Flaxseed
Spaghetti Wheat and milk

Prepared Flours

Aunt Jemima's Pancake Flour Wheat corn, rice rye, milk
Aunt Jemima's Buckwheat Flour Corn wheat buckwheat
H O Co Buckwheat Pancake Flour Cornmeal, buckwheat, wheat
Purina Health Pancake Flour Wheat, corn

Uncle Jerry's New England Corn and Rice Pancake Flour Corn, wheat, potato, rice, leavening
Uncle Jerry's New England Self Raising Buckwheat Flour Buckwheat wheat corn, leavening

Desserts

Blancmange Irish moss, milk, flavoring
Custard Egg milk, flavoring
Fritters Flour egg milk
Gelatin Cow, sheep goat pig and fish hides and connective tissue
Ice Cream Egg milk, flavoring
Ices Fruit egg flavoring
Meringue Egg, lemon

Pantry Supplies

Beef Juices Meat egg
Canned Tomato Soup Tomato, butter, onion, wheat, spices
Catsup Tomato spices, onion
Cottolene Cottonseed oil, beef suet
Crisco Spry Fluffo Cottonseed oil
Noodles Wheat egg
Potato Chips Potato cottonseed oil

TABLE 128

Recipes for Use in Allergy

(1) Chicken Croquettes

1 tbs oil or chicken fat	½ c liquid (chicken broth)
2 tbs cornstarch	¾ c cooked minced chicken
salt	

Make a sauce of fat, cornstarch, and liquid Add the other ingredients (Cooked corn meal may be added) Cool Shape and dip in rye flour or crushed corn flakes Bake in medium oven or fry in deep fat

(2) Corn Pone*

1 c corn meal	boiling water
½ tsp salt	1 tbs Mazola oil

Carefully pour enough boiling water onto the corn meal to make a stiff mixture, stirring constantly Add the oil and mix well Mold into oblong 'pones'' and fry in hot skillet with enough fat to prevent sticking When brown on one side, turn and brown on the other side Serve hot

*Fat used in recipes for greasing pans or shortening must be only oil or fat specified in the prescribed diet Baking powder should be Royal or Schilling which contains no egg

(3) Corn and Rice Muffins*

1/3 c rice flour	2½ tsp baking powder
½ c yellow corn meal	3 tbs Mazola oil
2 tbs sugar	½ c water

Mix all the dry ingredients well, sifting them together four or five times Add the water and oil Bake in a hot oven for 20 minutes Makes 6 small muffins

(4) Corn and Rye Muffins*

Use recipe for Corn and Rice Muffins, but substitute rye flour for rice flour

(5) Rice Biscuits

Made by the Battle Creek Sanitarium, Battle Creek, Mich

(6) Rice Bread*

1 c rice flour	1 tbs sugar
3 tsp baking powder	½ tsp salt
2 tbs bacon fat or oil	¾ c water

Sift the dry ingredients Add water and fat Bake in a loaf pan in a moderate oven

(7) Rye Rice Bread*

1/3 c rye flour	6 tsp sugar
2/3 c rice flour	5 tsp baking powder
½ tsp salt	2 tsp olive oil
	1 1/3 c water

Sift all the dry ingredients together Add water and oil Bake in a loaf pan in a moderate oven for 40 minutes

(8) Ry Krisp

Prepared by the Ralston Purina Company, St Louis, Mo

(9) Pear Butter

Select firm, ripe pears Peel, core, and cut into rather small pieces To 2 c of prepared fruit, add 1 c sugar Cook slowly, stirring frequently to prevent burning for 2 hours or until the mixture is quite thick

*Fat used in recipes for greasing pans or shortening must be *only* oil or fat specified in the prescribed diet Baking powder should be Royal or Schilling which contains no egg

(10) Rice Fruit Pudding Sauce

1 c sugar	1¼ c boiling water
2 tbs rice flour	1 tsp lemon juice or vanilla
½ tsp salt	

Mix sugar, salt, and cornstarch Add water and cook until thick Remove from stove and add flavoring Add boiled rice and apricots or sliced peaches and serve warm Reserve some sauce to pour over the pudding

(11) Tapioca-Fruit Pudding

2 halves peaches sliced	2 tsp sugar
1 tbs dry tapioca	½ c peach juice and water

Drain peaches and sprinkle with 1 tsp sugar Cook tapioca in juice and water until it is clear Add remaining sugar and salt Line a baking dish with peaches Fill with tapioca and bake in a moderate oven for 20 minutes

(12) Rice Cup Cakes*

⅔ c hot water	¼ c sugar
1½ c rice flour	¼ tsp salt
2 level tbs shortening	3 level tsp baking powder
1 tsp vanilla	

Pour hot water over half the flour Cream sugar and shortening and add to the above mixture, beating well Add the other ingredients, mixing well Bake in muffin pans for about 20 minutes in a fairly hot oven

(13) Lamb Patties

Ground lamb pressed into small patties Broiled or fried

(14) Puffed Rice Candy

1 c sugar	¼ tsp salt
½ c brown sugar	1 tsp vanilla
1 c water	Puffed rice

Cook sugar syrup, and water until brittle Add vanilla and salt Pour puffed rice, stirring all the time so that the kernels will be evenly coated Turn it into a greased pan and cut in squares Keeps well in an airtight container

(15) Tomatoes Cooked With Sugar

Select firm, ripe tomatoes Remove the skins, cut in slices, and drain an hour or more For each cup of tomatoes add a cup of sugar and boil until thick, stirring often Sliced lemon may be added to the tomatoes while cooking

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*Fat used in recipes for greasing pans or shortening must be only oil or fat specified in the prescribed diet Baking powder should be Royal or Schilling which contains no egg

(16) Chicken and Pineapple Salad

Cut cold boiled chicken into cubes and marinate for 2 hours in French dressing of oil and white vinegar and salt. Drain well, mix chicken with about one third its volume of diced pineapple, and add special mayonnaise, thinned with pineapple juice to taste.

(17) Split Pea Soup

1 c split peas	diced bacon (crisp)
1 tbs bacon fat	salt

Cook the peas until they form a smooth purée. Just before serving, add salt, bacon fat, and crispy fried bacon.

(18) Rye or Rice Cookies

1 c rye or rice flour	½ tsp soda
½ c light molasses (or syrup)	1½ tsp baking powder
3 tbs Wesson oil	1 tbs sugar
¼ tsp salt	Water to make a stiff dough

Mix dry ingredients. Add syrup, oil, and water. Drop on a greased cookie sheet and bake at 325° F for 15 minutes.

(19) Fruit Cornstarch Pudding

1½ c fruit pulp	2 tsp sugar
1½ c water	5 level tsp cornstarch

Cook for ½ hour in the top part of a double boiler.

(20) Tapioca With Apricots

6 halves apricots, puréed	1 tbs dry tapioca
2 tsp sugar	½ c juice and water

Cook the liquid and tapioca in a double boiler until tapioca is clear. Add apricots and blend well. Serve warm with apricot juice.

(21) Lima Bean Potato Muffins or Bread*

⅔ c potato flour	½ tsp salt
½ c Lima bean flour	4 tsp sugar
3 tsp baking powder	½ c water
2 tbs shortening	

Sift dry ingredients together. Melt fat and add to water, add slowly to dry ingredients. Put in greased muffin tins and bake at 400° F for 20 minutes. Serve hot. Makes 10 small muffins.

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*Fat used in recipes for greasing pans or shortening must be only oil or fat specified in the prescribed diet. Baking powder should be Royal or Schilling which contains no egg.

(22) Lima Bean Soya Bean Bread

Substitute soya bean flour for potato flour in recipe for potato Lima bean bread

(23) Boiled Mayonnaise

1 tsp sugar	juice of 1 large lemon
½ tsp salt	⅞ c boiling water
3 level tsp starch*	½ c Mazola oil

Mix sugar, salt, starch, and lemon juice Add water, cook until thick Remove from stove and slowly add oil, beating vigorously

(24) Purée of Lima Bean Soup

Wash and soak, for a few hours, 2 c Lima beans Cook in plenty of water salted to taste When beans are well done, put through a sieve

Cook small pieces of bacon, crisp Add enough bacon dripping and crisp fried bacon to purée to make palatable

(25) Lima Bean Potato Cake or Cookies†

6 tbs Lima bean flour	2½ tsp baking powder
¾ c potato flour	¼ tsp vanilla
5 tbs shortening	½ tsp lemon extract
½ c water	few grains salt
⅔ c sugar	few drops yellow coloring

Sift dry ingredients, cream fat and sugar, add dry ingredients and water alternately to creamed mixture Add flavorings and coloring Put in greased muffin tins and bake in oven at 430° F for 30 minutes

(26) Penoche Frosting

3 c brown sugar	¾ c water

Boil sugar and water until soft ball is formed when tested in cold water Remove from heat, cool, and beat until creamy An extra tablespoonful of water may be added if necessary for easy spreading White sugar may be used instead of brown, and vanilla or lemon flavoring may be added Chopped fruit may also be added if desired

(27) Carrot Marmalade

5 very large carrots	sugar
4 lemons	10 c water

Squeeze juice and add later Remove all seeds Then grind lemons and carrots together Add water Boil all this together for a good half hour, then measure it cup for cup of pulp and sugar Boil slowly for an hour, or until it jells Lemons vary slightly in congealing time

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*Use rice flour in Diet 1 cornstarch in Diet 2 and potato flour in Diet 3

†Fat used in recipes for greasing pans or shortening must be only oil or fat specified in the prescribed diet Baking powder should be Royal or Schilling which contains no egg

TABLE 129

SYMBOLS AND ABBREVIATIONS

Ad lib —as desired *(ad libitum)*
Avoir —avoirdupois
b i d —twice daily
bl , bbl —barrel
BHNHE—Bureau Human Nutrition and Home Economics
B M —basal metabolism or bowel movement
B M R —basal metabolic rate
B P —boiling point
bu —bushel
C—carbon
C —centigrade, carbohydrate
c —cup
Ca—calcium
cal —calorie
cap —capsule
c c —cubic centimeter, also occasionally written cu cm
cent —centigrade (centum meaning 100)
cg , cgm —centigram
Cl—chlorine, chlorin
cm —centimeter
C P —chemically pure
cryst —crystallized crystalline
Cu—copper
cu —cubic
D—500
decoct —decoction
[illegible]

dim —one half *(dimidius)*
dr —dram
dsp —dessert spoon
ea —each
e g —for example
et al —and others *(et alibi)*
et seq —and the following
F—fluorine, fluorin
F —Fahrenheit, fat
Fahr —Fahrenheit
Fe—iron
filt —filter
fl dr —fluid dram
fl oz —fluid ounce
gal —gallon
γ—gamma
gi —gill
gm —gram
gr —grain
gtt —drop *(guttae)*
H—hydrogen
Hb —hemoglobin
hr —hour
ht —height
I—iodine iodin
i d —daily *(in d e)*
ibid —in the same place *(ibidem)*
id —the same *(idem)*
in —inch
I U —International unit
kg , kgm , kilo—kilogram
kl —kiloliter
km —kilometer
L —liter
lb —pound *(libra)*
liq —liquor
M—1000
Mg—magnesium
mg —milligram
μg, mcg —microgram
min —minim
ml —milliliter or c c
mm —millimeter
Mn—manganese
N—nitrogen
Na—sodium *(natrium)*
Ni—nickel
No —number
noct —at night *(nocte)*
O—oxygen
o m —every morning *(omni mane)*
ol —oil *(oleum)*
os —mouth *(ostium)*
oz —ounce
P—phosphorus
P —protein
p c —after a meal *(post cibum)*
pH—index of acidity or alkalinity
pil —pill
pk —peck
pond —by weight *(pondere)*
ppt —precipitate
p r n —when required *(pro re nata)*
pt —pint
pulv —powder *(pulvis)*
q d —four times daily *(quater in die)*
q h —every hour *(quaque hora)*
q l —as much as one pleases *(quantum libet)*
qt —quart
R Q —respiratory quotient
℞—recipe, prescription
S—sulphur (sulfur)
sat —saturated
S D A —specific dynamic action
sig —let it be labeled *(signetur)*
sol —solution
solv —dissolve (solve)

TABLE 129—CONT'D

sp gr —specific gravity
spk —speck
sq —square
ssp —salt spoon
stat —immediately *(statim)*
sym —symmetric
syr —syrup (sirup)
T —temperature
tab —tablet
T (written with a capital to differentiate from a small t)
T, tb, tbs, tbsp — tablespoon
t i d —three times daily *(ter in die)*
tinct —tincture
t (written as small t to differentiate from T)
t, ts, tsp — teaspoon
u —unit
ur —urine
U S D A —United States Department of Agriculture
U S P —United States Pharmacopoeia
v —volume
vehic —vehicle
w g —water glass
wt —weight
Zn—zinc
<—less than
>—more than

TABLE 130

TABLE OF WEIGHTS AND MEASURES AND CONVERSION VALUES

1 c c = approximately 1 gm or 16 minims 1 min = 0 06 c c

A minim and a drop (gtt) are usually considered to be of equal size However, the size of the drop is dependent on the bore of the dropper *One cubic centimeter, therefore, may contain from* 12 to 20 drops or even 50 as in the dropper accompanying A D vitamin concentrates

Whether the cubic centimeter and gram are equivalent will depend upon the specific gravity (sp gr) of the liquid

1 standard tsp = 5 c c

Unfortunately, the old value of 4 c c continues to be used in many medical and pharmaceutical texts Teaspoons today contain 5 c c, and not 4 c c, as they did many years ago *A 4 c c teaspoon can be found in silver sets of two generations* ago or currently as a "five o'clock teaspoon" It is not a spoon in general use This old teaspoon is equivalent to 1 fl dr

1 dsp = 2 tsp
1 tbs = ½ fl oz = 4 drams = 15 c c
1 c = 16 tbs = 8 fl oz = 237 c c (approx 240 c c) = 2 gills = ½ pint
2 c = 1 pt
2 pt = 1 qt
1 qt = 0 946 L
1 L = 1 056 qt or 1,000 c c
4 qt = 1 gal
8 qt = 1 pk
4 pk = 1 bu
1 dr = ⅛ fl oz, 3 696 c c (approx 4 c c)
7 29 dr = 1 oz
1 fl oz = 29 574 c c (approx 30 c c or 2 tbs)
1 gr = 0 065 gm
1 gm = 15 gr
1 oz = 28 35 gm (approx 30 gm)
1 lb = 453 6 gm (approx 450 gm)
1 kilo = 2 2 lb
1 lb = 0 454 kilo

14 lb = 1 stone
1 stone = 6.35 kilo
10 mg = 1 cg
100 cg = 1 gm (A Buffalo nickel weighs 5 gm.)
1,000 g = 1 kg or kilo
2.5 cm = 1 in
40 in = 1 meter

*Conversion Table**

gr × 0.065 = gm
gm ÷ 15 = gr
in × 2.5 = cm
cm ÷ 2.5 = in
oz × 30 = gm
gm ÷ 30 = oz.
lbs × 2.2 = kilo
kilo ÷ 2.2 = lbs
Freezing 0° C or 32° F
Body temperature 37° C or 98.6° F
Boiling 100° C or 212° F
Fahrenheit to Centigrade—subtract 32 from 212 so that freezing points correspond then 180° F = 100° C, or 1° F = $\frac{100}{180}$ or 5/9° or 0.55 C, therefore the F figure − 32 × 5/9 or 0.55 = C, the C value × 9/5 or 1.8 + 32° = F

Example (98.6° F − 32) 5/9 = 37° C

*For exact conversion values see exact figure given above

Table 131

Food Composition Table for Short Method of Dietary Analysis*

Eva G Donelson and Jane M Leichsenring
Division of Home Economics, University of Minnesota, St Paul

The estimation of the nutritive value of a diet, following the usual procedure in which separate computations are made for each food item, assumes a greater degree of accuracy than is justified when the wide variation in composition of any given food is taken into consideration In view of this, a short method of dietary analysis was developed in which foods of similar composition were grouped together and mean values for each of the nutrients established

The accuracy of the values in this food composition table was tested on a series of 30 three day diet records These were computed first by the usual method whereby each individual food item is calculated separately, and then using the revised table Comparison of the results secured by the two methods showed a high degree of accuracy for the values in the food composition table. When tested statistically the observed differences were shown to be due to errors in random sampling and not to real differences between the two methods

FOOD	APPROXIMATE MEASURE	WT GM	CALORIES	PROT GM	FAT GM	CARBOHYDRATE GM	Ca GM	P GM	Fe MG	VIT A I U	ASCORBIC ACID MG	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG
Cereal products refined	1 sl bread (30 gm), ½ c cooked cereal and cereal products (20 gm dry), 1 c prep cereal (30 gm), 3 soda crackers (20 gm), 1½ c. pop corn (20 gm), 1 griddle cake		80	2 5	1	15	01	03	2	—	—	02	02	2
whole grain and enriched	1 sl bread (30 gm), ½ c cooked cereal (20 gm dry), 1 c prep cereal (30 gm), 2 graham crackers (20 gm)		80	2 5	1	15	01	04	6	—	—	06	04	6

*Reprinted from Journal of the American Dietetic Association 21 No 7 July August, 1945 by permission.

Dairy products butter	1 tsp	5	35	—	4	—	—	—	—	160	—	—	—	—
cheese, Cheddar type	1 cu in	30	120	7 0	10	1	25	18	3	430	—	01	14	—
cheese, cottage skim	½ c	100	100	19 0	1	4	08	26	2	70	—	01	13	—
cream light	⅛ c	30	60	1 0	6	1	03	02	1	260	—	01	04	—
custard	½ c	130	150	7 0	7	15	13	14	9	435	—	08	26	1
eggs	1 med	50	80	6 5	6	—	03	10	1 4	195	—	07	18	—
ice cream commercial	⅓ c	80	165	3 0	10	16	09	05	2	265	—	02	21	1
milk, buttermilk, skim	1 c	240	90	8 5	1	12	29	27	7	25	2	11	43	2
milk whole	1 c	240	160	8 5	9	12	28	22	5	410	2	10	43	3
Desserts cake plain chocolate	1 piece cake 2½ × 2½ 2½ in (75 gm) for iced add 1 serving sweets 1 waffle 6 in dia (60 gm)		225	4 0	11	28	03	06	8	175	—	09	11	6
cookies plain	2 med 3 in dia 1 brownie	40	150	2 0	7	20	01	03	3	155	—	04	03	2
pie crust	1/6 shell single crust	25	105	1 5	6	11	—	02	4	—	—	06	04	5
puddings cream fillings	½ c	140	210	4 5	6	35	16	13	6	270	—	06	22	1
Fats	2 sl bacon (20 gm) 1 tbsp fat (12 gm) 1 tbsp mayonnaise (15 gm) 1 cu in salt pork (15 gm) 1½ tbsp French dressing (15 gm)		120	1 0	13	—	—	01	2	5	—	01	01	2
Fish cod, haddock, fresh, cooked	1 med serving	75	50	12 5	—	—	01	14	1 5	—	—	05	06	8
halibut, herring tuna, whitefish, cooked	1 med serving, tuna (60 gm) others (75 gm)		105	15 0	5	—	02	17	8	35	—	04	08	2 4
salmon, canned	1 med serving	75	125	13 5	7	—	05	22	7	220	—	02	12	5 9

TABLE 131—CONT'D

FOOD	APPROXIMATE MEASURE	WT GM	CALORIES	PROT GM	FAT GM	CARBOHYDRATE GM	Ca GM	P GM	Fe MG	VIT A I U	ASCORBIC ACID MG	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG
Fruits banana	1 small	100	95	1 0	—	23	01	03	6	350	10	04	07	6
cantaloupe	½ melon, 4 ½ in dia	150	35	1 0	—	8	02	02	6	3 600	52	08	08	1
citrus	1 med orange, ½ med grape fruit, ½ c juice, 1 med large lemon	100	50	1 0	—	11	02	02	4	180	42	07	03	2
yellow fresh, canned, dried	fresh (100 gm), 1 med peach, 2 to 3 apricots 3 plums, dried (30 gm), add ½ serving sweets, for sweetened canned, dried or fresh, add 1 serving sweets		55	5	—	13	01	02	4	585	4	01	02	6
other, dried	3 to 4 dates 1½ to 2 small figs, dried apple, ½ c raisins	30	90	5	—	22	02	03	9	30	1	04	03	2
other, fresh and canned	½ c cooked, sweetened, add 1 serving sweets	100	65	5	—	15	01	01	4	80	6	02	02	1
Gravy, white sauce	¼ c	60	70	2 5	5	4	05	05	2	180	—	04	1	1
Legumes beans, peas,	½ c cooked, dried (30 gm)		105	6 5	—	19	03	12	2 4	20	—	14	06	5
soybeans	½ c cooked, dried (30 gm)		105	10 5	5	4	07	18	2 5	55	—	24	10	8
Meat beef, fowl, lamb, veal, cooked	1 med serving	75	160	18 0	10	—	01	18	3 1	20	—	09	15	3 9
liver, cooked	1 small serving	60	80	12 0	2	4	01	22	4 9	16,500	9	12	1 22	60
luncheon meats, cooked	2 sl sausage, minced ham, dried beef, luncheon roll (30 gm), ½ frankfurter (30 gm)		80	5 0	6	1	—	06	7	—	—	09	07	8
pork, ham, cooked	1 med serving	75	205	18 0	15	—	01	18	2 4	—	—	60	15	3 2
Nuts	1 tbsp peanut butter, 8 to 15 halves walnuts, 16 peanuts, 12 to 15 almonds, 12 halves pecans	15	95	3 5	8	3	01	06	3	—	—	03	02	1 4

Sweets candy, sugar, syrup	1 tbsp sugar, jelly, jam, syrup, honey, 1 serving plain Jello, plain candy (fondant or mints, 14 gm), 6 oz. bottle soft drink		55	—	—	14	—	—	—	—	—	—	—	—
candy bar	1 2 oz chocolate coated bar		275	5 0	13	35	05	10	1 1	—	—	03	09	3 3
molasses, sorghum	1 tbsp	20	50	—	—	12	04	01	1 3	—	—	01	04	—
Vegetables cabbage sauerkraut, cooked	¾ c	100	25	1 5	—	5	05	03	5	30	28*	05	04	2
cabbage, raw, cauliflower, cooked	1 c cabbage (50 gm), ⅔ c cauliflower (70 gm)		15	1 0	—	3	02	02	3	20	26	04	03	1
corn, parsnips, cooked	½ c corn 1 large parsnip	100	95	2 0	1	20	02	07	4	75	6	04	05	6
green and yellow, asparagus, cooked	⅔ c	100	25	2 0	—	4	02	04	9	775	38†	14†	11	1 0
broccoli, cooked	⅔ c	100	35	3 5	—	6	15	08	1 4	4,800	63	08	23	6
carrots cooked	⅔ c	100	40	1 0	—	9	04	04	8	12,000	3	04	06	5
green beans, cooked	⅔ c	100	40	2 5	—	8	06	04	1 4	480	13†	06†	12	4
leafy green, cooked	⅔ c kale, spinach turnip other greens	100	30	2 5	—	4	25‡	05	2 7	6 285	46†	08†	27	5
peas, fresh, cooked, canned	½ c	100	70	4 5	—	12	02	09	1 4	590	11†	15†	09	1 1
sweet potato, cooked	½ large	100	130	2 0	1	28	04	05	7	5 920	14	08	06	5
potato, cooked	1 small, for fried add 1 serving fats	100	85	2 0	—	19	01	05	7	35	8	08	03	1 0
tomato, fresh, canned, juice	½ c, 1 small tomato (100 gm), 2½ tbsp catsup (50 gm) add ½ serving sweets		20	1 0	—	4	01	02	6	900	19	05	03	7
other, cooked	½ c beets, eggplant, onions, rutabagas, etc	100	45	1 5	—	10	04	04	6	—	8	01	02	2
other, commonly served raw	2 pieces celery 8 sl cucumber, ⅛ hd lettuce	50	10	0 5	—	2	02	01	2	70	3	03	02	1

The nutritive value of food mixtures such as macaroni and cheese Spanish rice chow mein creamed vegetables soups etc should be computed on the basis of the kind and approximate amount of the foods in the combination *For sauerkraut omit ascorbic acid †For canned reduce ascorbic acid and thiamin by one half ‡Calcium unavailable in chard spinach and beet greens

TABLE 132

WEIGHT HEIGHT AGE TABLE FOR GIRLS

From Birth to School Age

HEIGHT (INCHES)	1 MO	3 MO	6 MO	9 MO	12 MO	18 MO	24 MO	30 MO	36 MO	48 MO	60 MO	72 MO
20	8											
21	9	10										
22	10	11										
23	11	12	13									
24	12	13	14	14								
25	13	14	15	15								
26		15	16	17	17							
27		16	17	18	18							
28			19	19	19	19						
29			19	20	20	20						
30			21	21	21	21	21					
31				22	22	23	23	23				
32					23	24	24	24	25			
33						25	25	25	26			
34						26	26	26	27			
35						29	29	29	29	29		
36							30	30	30	30	31	
37							31	31	31	31	32	
38								33	33	33	33	
39								34	34	34	34	34
40									35	36	36	36
41										37	37	37
42										39	39	39
43										40	41	41
44											42	42
45												45
46												47
47												50
48												52

Prepared by Robert M Woodbury Ph D Children s Bureau U S Department of Labor 1923

Weight is stated to the nearest pound height to the nearest inch age to the nearest month

Weights of children under 35 inches were taken without clothing those of children above 35 inches with clothing (shoes coat and sweater removed)

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TABLE 133

WEIGHT HEIGHT AGE TABLE FOR BOYS

From Birth to School Age

HEIGHT (INCHES)	1 MO	3 MO	6 MO	9 MO	12 MO	18 MO	24 MO	30 MO	36 MO	48 MO	60 MO	72 MO
20	8											
21	9	10										
22	10	11										
23	11	12	13									
24	12	13	14									
25	13	14	15	16								
26		15	17	17	18							
27		16	18	18	19							
28			19	19	20	20						
29			20	21	21	21						
30			--	22	22	22	22					
31				23	23	23	23	24				
32				24	24	24	25	25				
33					26	26	26	26	26			
34						27	27	27	27			
35						29	29	29	29	29		
36							30	31	31	31		
37							32	32	32	32	32	
38								33	33	33	34	
39								35	35	35	35	
40									36	36	36	36
41										38	38	38
42										39	39	39
43										41	41	41
44											43	43
45											45	45
46												48
47												50
48												52
49												55

Prepared by Robert M Woodbury Ph D Children's Bureau U S Department of Labor 1923

Weighing children is a means of ascertaining their rate of growth All children should make a regular annual gain Tables 26 to 29 [of the original publication] should be used as a means of interesting parents in their children's growth

Lay infant on table on which has been placed an accurate measure Stand child with heels and shoulders against a wall upon which has been marked or pasted an accurate measure

Encourage the annual physical examination of every child by a physician

TABLE 134

WEIGHT-HEIGHT-AGE TABLE FOR GIRLS

HEIGHT INCHES	5 YR.	6 YR.	7 YR	8 YR	9 YR	10 YR	11 YR	12 YR	13 YR	14 YR	15 YR	16 YR.	17 YR	18 YR.
38	33	33												
39	34	34												
40	36	36	36											
41	37	37	37											
42	39	39	39											
43	41	41	41	41										
44	42	42	42	42										
45	45	45	45	45	45									
46	47	47	47	48	48									
47	49	50	50	50	50	50								
48		52	52	52	52	53	53							
49		54	54	55	55	56	56							
50		56	56	57	58	59	61	62						
51			59	60	61	61	63	65						
52			63	64	64	64	65	75						
53			66	67	67	68	68	67	71					
54				69	70	70	71	69	73					
55				72	74	74	74	71	77	78				
56					76	78	78	79	81	83				
57					80	82	82	82	84	88	92			
58						84	86	86	88	93	96	101		
59						87	90	90	92	96	100	103	104	
60						91	95	95	97	101	105	108	109	111
61							99	100	101	105	108	112	113	116
62							104	105	106	109	113	115	117	118
63								110	110	112	116	117	119	120
64								114	115	117	119	120	122	123
65								118	120	121	122	123	125	126
66									124	124	125	128	129	130
67									128	130	131	133	133	135
68									131	133	135	136	138	138
69										135	137	138	140	142
70										136	138	140	142	144
71										138	140	142	144	145

Prepared by Bird T Baldwin Ph D and Thomas D Wood M D

When taking measurements remove the child s outdoor clothing shoes and coat Take heights with a square consisting of two flat pieces of wood joined at right angles (a chalk box will serve) The child is placed in a good erect position with heels and shoulders against the wall or wide board upon which has been marked or pasted an accurate measure Age is taken to the nearest birthday

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TABLE 135

WEIGHT HEIGHT AGE TABLE FOR BOYS

HEIGHT INCHES	5 YR	6 YR	7 YR	8 YR	9 YR	10 YR	11 YR	12 YR	13 YR	14 YR	15 YR	16 YR	17 YR	18 YR	19 YR
38	34	4													
39	35	35													
40	36	36													
41	38	38	38												
42	39	39	39	39											
43	41	41	41	41											
44	44	44	44	44											
45	46	46	46	46	46										
46	47	48	48	48	48										
47	49	50	50	50	50	50									
48		52	53	53	53	53									
49		55	55	55	55	55	55								
50		57	58	58	58	58	58	58							
51			61	61	61	61	61	61							
52			63	64	64	64	64	64	64						
53			66	67	67	67	67	68	68						
54				70	70	70	70	71	71	72					
55				72	72	73	73	74	74	74					
56				75	76	77	77	77	78	78	80				
57					79	80	81	81	82	83	83				
58					83	84	84	85	85	86	87				
59						87	88	89	89	90	90	90			
60						91	92	92	93	94	95	96			
61							95	96	97	99	100	103	106		
62							100	101	102	103	104	107	111	116	
63							105	106	107	108	110	113	118	123	127
64								109	111	113	115	117	121	126	130
65								114	117	118	120	122	127	131	134
66									119	122	125	128	132	136	139
67									124	128	130	134	136	139	142
68										134	134	137	141	143	147
69										137	139	143	146	149	152
70										143	144	145	148	151	155
71										148	150	151	152	154	159
72											153	155	156	158	163
73											157	160	162	164	167
74											160	164	168	170	171

Prepared by Bird T Baldwin Ph D and Thomas D Wood M D

These tables were constructed [illegible]
sumably healthy children most [illegible]
age weight for height and age [illegible]
and height *normally* show wide [illegible]
and depth of the skeletal frame [illegible]
as height in determining body [illegible]
interpreting the *significance* of deviation from average weight for height
Weight for height alone is not a dependable index of nutritional status
(February 193[illegible])

TABLE 136

TERMINAL STERILIZATION PROCEDURE FOR FORMULA PREPARATION

Strong Memorial Hospital—Rochester Municipal Hospital
Rochester, New York

Hints on Easy Formula Preparation

1 Use the same equipment every day Use it only for the formula Keep everything for the formula together Make the formula the same way every day

2 After the feeding fill nursing bottle with cold water, rinse the nipple, and squeeze cold water through holes of nipple

Equipment (all should be clean)

1 Large enamel pail with tight cover

2 Bottle rack (a clean folded dish towel may be used instead of a rack, if necessary)

3 Sufficient nursing bottles, nipples, and caps for each feeding for 24 hours

4 Sufficient nursing bottles, nipples, and caps for orange juice and water feedings for 24 hours

5 1 Tablespoon (or set of measuring spoons)
1 teaspoon

6 Measuring cup

7 1 knife

8 Funnel

9 Can opener or punch if canned milk is used

10 Mixing pan

11 Metal kitchen tongs, if available

Method

1 Wash your hands Put on a clean apron

2 Wash bottles nipples and caps in warm, soapy water using a bottle nipper brush Rinse well and drain

3 Boil nipples and caps for three minutes

4 Measure sugar into mixing pan

5 Measure cold water from faucet into mixing pan Stir to dissolve sugar

6 Wash top of can or bottle Open can with can opener or punch Measure milk and add to mixing pan Stir thoroughly

7 Pour measured amount of formula for one feeding into each bottle

8 Close each bottle with boiled nipple Do not touch the tip of the nipples If pasteurized milk is used, place a piece of gauze across the top of each bottle held in place by the nipple

9 Cover nipples with cap, leaving cap tilted slightly so steam can get to nipple If you do not have caps, use paper caps made from clean wrapping or wax paper tieing them loosely in place with string so that steam can get to nipple.

10 Put filled and capped bottles into pail

11 The bottles of drinking water and the empty bottle for orange juice can be put in at the same time

12 Fill pail with warm water up to the level of two inches

13 Place on stove, and when water is boiling, allow to boil for 15 minutes Have cover tight on pail

14 Take pail off stove Cool bottles by pouring cool water slowly down side of pail to height of formula level in bottle Do not let water splash on caps or come up around nipple and covers

15 Remove and place in a pan of cold water up to level of formula Tighten caps

16 If pasteurized milk is used shake bottles gently during early cooking period to help eliminate scum

TABLE 137

PROTEIN IN RELATION TO GROWTH RATE

ANIMAL	DAYS REQUIRED TO DOUBLE BIRTH WEIGHT	PROTEIN %	LIME %	PHOSPHORIC ACID %
Man	180	1.6	0.328	0.473
Horse	60	2.0	1.210	1.310
Cow	47	3.5	1.600	1.970
Goat	19	4.3	2.100	3.220
Pig	18	5.9	–	–
Sheep	10	6.5	2.720	4.120
Dog	8	7.1	4.530	4.930
Cat	7	9.5	–	–

TABLE 138.—COMPOSITION OF FOODS, COMMON HOUSEHOLD UNITS

This table (Table 3 in the original publication), together with the following introduction is reprinted by permission from *Composition of Foods—Raw, Processed, Prepared*, U S Department of Agriculture Handbook No 8 by Bernice K Watt and Annabel L Merrill

Explanation of Table

This table is useful in estimating nutrient values of unweighed portions of foods as served and in rating individual diets in certain types of dietary surveys For many foods the unit shown is 1 cupful because this quantity can be adjusted readily to servings of various sizes For some foods, the unit shown is a given number of ounces if that approaches a reasonable portion or serving and information is lacking for computing other units One pound portions of numerous home prepared foods have been included to facilitate computations for certain types of dietary studies

The weights of common household units of food and their approximate measures shown in this table were taken from several sources, published and unpublished or were calculated from the density of the food The weights thus obtained in many instances do not represent a high degree of accuracy for the volume or measure but the nutrient values in the table are for the weight specified Weights per volume or count reported by different laboratories or individuals varied widely in many cases and the approximate measure and the food itself were not always adequately described in the report To minimize the errors in interpreting the units of measure and weight, descriptions have been made as specific and adequate as possible

Sources of Data

The data appearing in this table has been compiled over a period of years from published and unpublished literature and except in a few cases, are averages of original analytical data It is not practicable to list the numerous sources in detail

Research at colleges, universities and Agricultural Experiment Stations, as well as research by scientific organizations and by industry, have contributed the major portion of the data used for deriving the averages As new data on any food item became available in the literature or from unpublished sources, they were added to the array on file, if suitable, and a new average derived For some foods, chiefly in the case of the mineral content, data were taken from other compilations, especially published

summaries of Henry C Sherman In other instances data are the result of investigations in a single laboratory For example, figures on the proximate composition of cooked fish were supplied by courtesy of the Bureau of Fisheries, U S Department of Interior, from unpublished work in their laboratories

A brief out
give the user
tables of food
in 1896, and re
composition and energy value of an extensive list of foods The tables contained minimum, maximum, and average values for water, protein, fat, carbohydrate, ash content, and energy value of the edible portion of the food and for refuse as well The data were compiled by W O Atwater and his associates and were based in large measure on their own work and that of their colleagues, most of whom were working in Agricultural Experiment Stations and on a few experiments from foreign laboratories

Since that time, compilation of data from original sources has been continued by the Department of Agriculture, and, at intervals, publications have been issued covering various phases of work on the composition of foods A complete revision of the original tables was made by Charlotte Chatfield and Georgian Adams and published in 1940 The composition figures were brought up to date, taking into account changes in processing of foods and the introduction of new fruits and vegetables and new varieties

As mineral and vitamin values of foods appeared in the literature or otherwise became available they also were added to the food composition files When an urgent need arose early in World War II for a single food table showing not only calories and proximate composition but mineral and vitamin values as well, compilations of data were supplied by the Department and others to the Committee on Food Composition of the National Research Council's Food and Nutrition Board and used by them in a preliminary processed table The table was revised and expanded as unpublished analyses were assembled by the efforts of that Committee and new research results became available A printed edition, *Tables of Food Composition in Terms of Eleven Nutrients*, Miscellaneous Publication No 572 containing data on 275 foods was published in 1945 by the U S Department of Agriculture in cooperation with the National Research Council

The present publication takes into account much new material Figures have been revised as needed, and there have been added numerous foods not listed in the 1945 table as well as different forms of food, especially frozen and cooked foods

Notes About Food Items

In preparing this table an effort has been made to derive values typical of the product available the year around throughout the country At present, however, it is impossible to prepare average composition values that are uniformly representative for all foods or even for all constituents of any one food Some foods have been analyzed repeatedly for their content of a few nutrients and scarcely at all for other nutrients

Cooked foods, a few prepared dishes, and frozen foods have been included in the table for the first time Figures for these items are preliminary, in many cases based on very little experimental work However, even in tentative form they more closely approximate the nutrient content of food as eaten than do data on uncooked foods So far as possible the data presented were based on summaries of reported analyses, where necessary, however values were imputed either from another form of the same food or from a similar food For example, in only a few cases were suitable analyses available on which to base figures for either the proximate or mineral composition of frozen foods or cooked vegetables Where actual

data were lacking or appeared to be inconsistent, the composition of the drained portion of the canned food or of the raw product was used.

For cooked vegetables, vitamin values are based on studies in which fair to good cooking procedures were followed. Unless otherwise indicated, the values shown may be applied to vegetables cooked not too long in a moderate amount of water. Amount of water and length of time required to bring water back to boiling are two of the more important factors in vitamin retention. Small amounts of water and short heat-up periods would result in higher vitamin content than shown in this table. Conversely, if the vegetable was started in a large amount of cold water, the values would be lower because of increased solution and destruction. Reheated left-over vegetables would have much less thiamine and ascorbic acid than shown by the figures in the table.

Enriched Flour.—The minimum levels for the required nutrients covered by the Federal enrichment legislation for flour have been entered in this table. These minimum levels are thiamine 2.0 mg., riboflavin 1.2 mg., niacin 16 mg., and iron 13 mg. per pound. In addition to the amounts of iron and the three vitamins specified, certain levels of vitamin D and calcium were permitted as optional ingredients. Vitamin D is not included in this table, and except for self-rising flours it has been assumed that manufacturers ordinarily do not add calcium.

Self-rising Flour, as usually prepared, contains dicalcium phosphate, although sometimes a sodium salt is used. Self-rising flour containing the calcium salt is estimated to have approximately 1,235 mg. of calcium per pound and this figure appears in the table. The minimum amount required for enrichment is only 500 mg. per pound and hence both the enriched and the unenriched self-rising flours, as customarily prepared, have more calcium than the minimum level.

Bread and Rolls.—The nutritive values shown for breads and rolls are the result of calculations made from formulas considered typical of present-day commercial baking practices. Breads with 2% increments of nonfat milk solids up to the 6% level (flour basis, that is, 6 pounds nonfat milk powder per 100 pounds flour) have been entered because this range is believed to cover most of the white breads sold. For calculating nutritive values of diets when the level of milk solids in commercial bread is unknown, the bread having milk solids at the 4% level (flour basis) is suggested because present information indicates that the average amount of milk used is between 3 and 4% (flour basis). Bread made with 4 pounds of milk solids to 100 pounds of flour contains approximately 2½% of milk solids after baking. There is wide variation in the amount of milk used in bread. Instances are known in which bakers use as much as three and four times the average. A significant portion of the calcium content of breads shown in this table is from the mold inhibitor. In calculating the values for commercial white bread, it was assumed that 0.2 pound of calcium proprionate was used to 100 pounds of flour. In the 4% milk bread, the calcium propionate would account for about 110 mg. of the calcium in a pound of bread.

Enriched bread may be made either with enriched flour or with unenriched flour plus such other ingredients that 1 pound of the finished product will have not less than the minimum nor more than the maximum levels of certain nutrients as specified in the proposed Federal standards. The amounts of the nutrients specified appeared in the Federal Register for August 3, 1943, as follows:

	Minimum mg./lb.	*Maximum mg./lb.*
Iron	8.0	12.5
Thiamine	1.1	1.8
Riboflavin	0.7	1.6
Niacin	10.0	15.0

The minimum levels of iron, thiamine, riboflavin, and niacin in the proposed specifications for enriched bread have been entered in this table In calculating the nutrients, it has been assumed that the breads were made with unenriched flour and that the amounts of the nutrients needed to meet the minimum levels specified for enrichment in addition to the amounts contributed by the ingredients of the formula would be supplied by adjusted enrichment preparations However, if enriched flour was used along with significant quantities of nonfat milk solids, the level of these nutrients, riboflavin especially, would be higher The effect of increasing milk solids by 2% increments may be observed by comparing the nutrient content of the unenriched breads having nonfat milk solids at the different levels specified

Breakfast food cereals on the market tend more and more to have added nutrients Nutritive values approximating some of these products have been included in the table The nutrients usually added to these breakfast foods include one or more of the following iron, thiamine, riboflavin, and niacin Except for enriched farina and enriched grits, there are at present no Federal standards regarding the addition of nutrients, either as to the nutrient that may be added or its level in the finished product The values for the breakfast foods with added nutrients shown in this table are averages of the composition data reported for commercial products that have the same generic classification and have approximately the same levels of added nutrients Before using these data in any particular calculation, as in dietary studies, it would be well to check the data with the information given on the packages of several kinds in the current market to see whether values in this table are applicable

Meat of medium fatness for each kind of animal makes up the main portion of meat consumed in this country and was therefore used as the basis for most of the data entered in the present table

Composition data for meat of other degrees of fatness are entered for the carcass or side as a whole In addition, under pork, the item "miscellaneous lean cuts" has been included for use when a figure is needed to represent the total of the so called lean cuts of a medium fat carcass that go into ordinary retail channels Excluded are the lard, bacon, salt side, and fat back

Reliable average values on the proximate composition of wholesale cuts have been available for several years and have been used quite generally in dietary calculations for estimating the nutritive values of meat When wholesale cuts of medium fatness are trimmed, fat along with some bone and a very little lean is often removed The extent of the trimming is highly variable, and the composition of trimmed cuts cannot be estimated as accurately as that of wholesale cuts For evaluating diets, the use of composition data on wholesale cuts, particularly in the case of beef, introduces considerable overestimation of fat and calories and a small underestimation of protein The data for some of the fresh beef cuts shown in this table have been adjusted to allow for a moderate amount of trimming Data for all other fresh meat cuts, including lamb, pork and veal, are from wholesale cuts considered most suitable

Data for cooked meats were estimated from studies relating to changes in the composition of meat during cooking Among the most important factors influencing these changes are temperature of cooking and degree of doneness In so far as possible, data used to derive values for cooked meat in this table were from experiments in which the meat had been cooked to medium doneness at moderate temperatures by common methods suitable for the particular cut Meat shrinks when cooked losing water, fat, some mineral matter and a little protein The total loss in weight appears to be around 20 to 30% for meat with bone and about 30 to 40%

for meat without bone. Meat roasted at a very low temperature would be expected to shrink less than at higher temperatures. Reheating of left-over meat would reduce considerably the thiamine values shown in this table.

Notes on Nutrients and Other Components

Refuse figures refer to the percentage of the total purchased weight that the homemaker usually discards in preparing food for the family table. Refuse includes bones, pits, shells, and other inedible material. For some foods it includes portions that could be eaten but as a rule are discarded; for example, potato parings and tough outer leaves of vegetables. In general, data on refuse have been based on products in good condition and would not be suitable to apply to produce with excessive bruising, insect infestation, or rot, nor would they apply if peeling and trimming are done extravagantly. In other words, data shown here for refuse do not include *waste*. The figures are considered suitable for use with food supplies purchased at retail but generally are not satisfactory for use with fresh produce bought at wholesale.

Proximate composition of food is the term which has come to be applied to the proportion of water, fat, carbohydrate, protein, and ash present in the food. Each component is made up of substances having some properties in common, but may include smaller amounts of substances that are unrelated chemically. This proximate grouping of long standing is convenient and is useful for many calculations.

Protein values have been calculated from nitrogen content, nearly always total nitrogen, by applying suitable conversion factors such as those published by Jones.[1] Counted with the true protein are other nitrogenous compounds such as amino acids and the purine bases. In cases where the nonprotein nitrogen, exclusive of amino acid nitrogen, is fairly large, the figures for the protein content of the food have been adjusted to more nearly represent the sum of the true protein and amino acids present.

Fat refers, in the main, to ether-extractable materials including, in addition to the glyceryl esters of fatty acids or true fats, various fatty acids, sterols, chlorophyl, and other pigments or substances of similar solubility.

Carbohydrate, frequently referred to as "total carbohydrate by difference" is the term that has come to be used in this country to apply to the balance of the food components and is the difference between 100% and the sum of the percentages of protein, fat, ash, and water. In addition to the sugars and starches which the body uses almost completely, it includes other forms of carbohydrate which the body utilizes to a lesser degree if at all, such as fiber and pentosans. Included also are other substances that are not carbohydrate, such as organic acids.

Food Energy.—Calories are the units used for expressing food energy. In this publication calories have been calculated by a modification of the procedure that has been in use in this country for 50 years. Instead of applying the general caloric factors 4, 9, 4 to the percentage composition of protein, fat, and carbohydrate, respectively, as has usually been done heretofore, more specific factors have been developed for individual foods or food groups. These more specific factors have been developed along the lines of Atwater's plan but take into consideration the more recent literature on digestibility and physiological energy value of foods.

The principle for this revised procedure of estimating the caloric values was published[2] in the report of the Committee on Calorie Conversion Factors and Food Composition Tables, convened by the Nutrition Division of

[1]Jones, D. B. Factors for Converting Percentages of Nitrogen in Foods and Feeds Into Percentages of Protein. U. S. Dept. Agric. Cir. 183, 22 pp. 1941 (Slrev. ed.)

[2]Food and Agriculture Organization, Nutrition Division. Energy-yielding Components of Food and Computation of Calorie Values. 23 pp. 1947.

the Food and Agriculture Organization Details of applying this procedure in the estimation of the calorie values of wheat flours of different extractions have also been published [3] Factors not shown in either of these publications for calculating the calories from protein fat, and carbohydrate in foods were based on an unpublished compilation of data in the files of the Bureau of Human Nutrition and Home Economics

Calcium, phosphorus, and iron data shown in this table represent the total amounts of these elements present unless otherwise noted The question of how to treat the calcium content of foods containing relatively large amounts of oxalic acid remains debatable In this table the total calcium content is given but attention is called in a footnote to the possibility that all of it may not be available because of the presence of the oxalic acid Likewise, deductions were not made for phytin present in the food

Vitamin values in the literature for any one vitamin have been determined by a number of methods In some cases the early exploratory procedures have been replaced by methods now thought to be highly reliable but the more reliable methods have not yet been applied to all foods The application of better methods will call for a revision in some of the figures

Vitamin A values in this table are expressed in International Units They have been based, in part, on biological assay and, in part, on physical or chemical determinations of vitamin A itself or on one of its precursors The physiological equivalence of vitamin A and of the carotenes having vitamin A activity has posed difficult questions Scientists around the globe are not entirely in agreement as to how much carotene is equivalent to an International Unit of vitamin A For this table, values expressed as micrograms of carotene were converted to I U of vitamin A on the basis that 0 6 microgram of beta carotene and 1 2 micrograms of other carotenes having vitamin A activity were equivalent to 1 I U of vitamin A The problem of deriving suitable values for practical use in evaluating human diets is still further complicated by differences in availability of carotene from different sources Experimental work with laboratory animals and human subjects have shown that the carotene in some foods is nearly all available and in others only one third or less is available Future revisions of vitamin tables probably will require considerable change in vitamin A figures

B Vitamins—Methods of extraction and assay for the three B vitamins (thiamine, riboflavin niacin) included in the table are still in the process of development Modifications of the preferred methods are resulting in greater sensitivity and precision and consequently in better agreement between methods Results of applying the improved procedures have not as yet been reported for a great many foods, consequently many of the values are based on older methods There is still considerable doubt concerning the adequacy of present methods for the release of the bound forms of riboflavin anomalous values are occasionally reported for the retention of this vitamin in foods that have been subjected to heat Niacin values were derived from data in the literature measuring nicotinic acid, nicotinamide and related active compounds

Ascorbic acid values reported here have been based for the most part on determinations of reduced ascorbic acid because this was the form reported by most workers and is the form in which nearly all of this vitamin occurs in fresh products Foods that have undergone storage or processing, however, have been found to contain significant quantities of the oxidized form (dehydroascorbic acid) Data on total ascorbic acid were used when authors reported data on both the reduced and the dehydro forms Since data for estimating total ascorbic acid were far less often reported there may be some underestimation of the vitamin C value of the foods On the other

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[3] Merrill A L and Watt B K Physiologic Energy Values of Wheat J Am Dietet A 24 953 956 1948

hand recent developments in methods for measuring the vitamin C value of products show that some foods contain interfering substances which react chemically like the vitamin but do not have the same physiological activity These interfering substances are found especially in foods having a high carbohydrate content that have been subjected to heat or unfavorable storage conditions Continued research on methods and application of the improved procedures are needed to show to what extent present data need revision

Signs and Symbols Used

An asterisk indicates an item for which the composition has been calculated from a recipe

Parentheses denote imputed values for which little or no experimental evidence was available, for which there was relatively little basis for imputing a value from another form of the food, or for which reported data were not considered suitable A zero in parentheses is used where actual data were lacking and the amount of a constituent present was regarded as none or probably too little to measure

Dashes show that no basis could be found for imputing a value although there was some reason to believe that a measurable amount of the constituent might be present

The word "Trace" is used to indicate vitamin values that would round to zero with the number of decimal places carried in these tables For other components that would round to zero a zero is used A zero followed by a decimal point indicates that there may be up to 0 5 of the unit present but bases for showing the amount were inadequate Numbers with or without decimal points indicate that the average has been rounded to the nearest whole number, or in the case of vitamin A to the nearest multiple of ten

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
1	Almonds, dried, unblanched												
a	Shelled, 1 cup (142 gm)	848	26 4	76 8	27 8	361	674	6 2	0	35	95	6 5	Trace
b	In shell, 1 cup (78 gm)	238	7 4	21 6	7 8	102	190	1 8	0	.10	27	1 8	Trace
	Apples												
2	Raw, A P refuse, 12%												
a	1 large (3 in diam, 230 gm)	117	6	8	30 1	12	20	6	180	08	06	4	9
b	1 medium (2½ in diam, 150 gm)	76	4	5	19 7	8	13	4	120	05	04	2	6
c	1 small 2¼ in diam, 114 gm)	58	3	4	14 9	6	10	3	90	04	03	2	5
	Raw, E P												
d	1 cup cubed or sliced (142 gm)	83	4	6	21 2	9	14	4	130	06	04	3	7
	Canned See Applesauce												
3	Dehydrated (small pieces), 1 pound	1,606	8 2	10 9	413 1	109	277	8 2	(0)	33	47	5 4	53
	Dried												
4	Uncooked, 1 cup (114 gm)	315	1 6	1 1	83 4	22	55	1 6	(0)	11	11	1 1	14
5	*Cooked, unsweetened												
a	1 pound	358	1 8	1 4	94 4	23	64	1 8	(0)	09	14	1 4	9
b	1 cup (255 gm)	201	1 0	8	53 0	13	36	1 0	(0)	05	08	8	5
6	*Cooked, sweetened												
a	1 pound	477	1 8	1 4	124 8	23	54	1 8	(0)	09	09	9	9
b	1 cup (280 gm)	294	1 1	8	77 0	14	34	1 1	(0)	06	06	6	6
7	Apples and apricots, canned, strained (infant food), 1 ounce	18	1	1	4 7	3	5	3	300	01	01	1	1
8	*Apple Betty												
a	1 pound	680	7 7	13 2	138 9	68	114	5	730	26	18	2 2	5
b	1 cup (230 gm)	344	3 9	6 7	70 4	34	58	2	370	13	09	1 1	3
9	Apple butter												
a	1 cup (282 gm)	518	1 1	2 3	128 0	39	59	1 7	(0)	03	06	4	5
b	1 tablespoon (18 gm)	33	1	1	8 2	3	4	1	(0)	Trace	Trace	Trace	Trace

10	Apple juice, fresh or canned, 1 cup (249 gm)	124	2	(0)	34.4	15	25	1.2	90	05	07	Trace	2
	Applesauce, canned												
11	Unsweetened, 1 cup (239 gm)	100	5	5	26.1	10	19	1.0	70	05	02	.1	3
12	Sweetened, 1 cup (254 gm)	184	5	3	50.0	10	20	1.0	80	05	.03	1	3
13	Strained (infant food), 1 ounce	17	1	1	4.5	1	2	1	20	Trace	Trace	Trace	1
	Apricots												
14	Raw, 3 apricots (114 gm), ref use, pits, 6%	51	1.1	1	13.8	17	25	5	2,890	03	05	9	7
	Canned												
15	Water pack, 1 cup halves and liquid (244 gm)	77	1.2	2	19.8	24	37	7	3,300	04	05	8	10
16	Syrup pack												
a	1 cup halves and syrup (256 gm)	205	1.5	3	54.8	26	38	8	3,410	04	06	8	10
b	*4 medium halves and 2* tablespoons syrup (122 gm)	97	7	1	26.1	12	18	4	1,650	02	03	4	5
17	Strained (infant food), 1 ounce	17	3	1	4.3	6	9	(3)	(480)	(01)	(01)	(1)	(1)
	Dried, sulfured												
18	Uncooked												
a	Large 1 cup (28 halves, 162 gm)	423	8.4	6	108.4	139	193	7.9	12,040	02	25	5.3	20
b	Small, 1 cup (40 halves, 150 gm)	393	7.8	6	100.4	129	178	7.4	11,140	02	24	4.9	19
19	*Cooked, unsweetened, fruit and liquid												
a	1 pound	386	7.7	5	99.0	127	177	7.3	10,990	02	.23	4.5	14
b	1 cup (approx 25 halves, 285 gm)	242	4.8	3	62.1	80	111	4.6	6,900	01	14	2.8	9
20	*Cooked, sweetened, fruit and syrup												
a	1 pound	559	6.8	5	143.5	109	154	6.4	9,580	01	18	4.1	14
b	1 cup (approx 25 halves, 325 gm)	400	4.9	3	102.7	78	110	4.6	6,860	01	.13	2.9	10
21	Frozen, 3 ounces	70	6	1	17.9	9	14	3	1,410	02	03	4	3

Note *Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value*

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Asparagus												
23	Cooked												
a	1 pound	92	10 9	9	16 3	86	241	4 5	4,720	59	77	5 4	104
b	1 cup cut spears (175 gm)	36	4 2	4	6 3	33	93	1 8	1,820	23	30	2 1	40
	Canned, green												
24	Solids and liquid												
a	1 cup cut spears with liquid (239 gm)	42	4 5	7	6 9	43	103	4 1	1,450	16	23	2 1	35
b	6 spears, medium size, with 2 tablespoons liquid, 126 gm)	22	2 4	4	3 7	23	54	2 1	760	09	12	1 1	19
25	Drained solids												
a	1 pound	97	10 9	1 8	15 4	86	241	8 6	3,630	30	37	4 4	80
b	1 cup cut spears (175 gm)	38	4 2	7	6 0	33	93	3 3	1,400	11	14	1 7	31
c	6 spears, medium size (96 gm)	21	2 3	4	3 3	18	51	1 8	770	06	08	9	17
	Canned, bleached												
26	Solids and liquid												
a	1 cup cut spears with liquid (239 gm)	43	3 8	7	7 9	36	79	2 2	110	13	16	1 8	35
b	6 spears, medium size, with 2 tablespoons liquid (126 gm)	23	2 0	4	4 2	19	42	1 1	60	07	08	9	19
27	Drained solids												
a	1 cup cut spears (175 gm)	39	3 7	9	6 3	28	72	1 8	140	09	13	(1 5)	31
b	6 spears, medium size (96 gm)	22	2 0	5	3 5	15	39	1 0	70	05	07	(8)	17
29	Avocados, raw[1]												
a	1 cup (½ in cubes, 152 gm)	372	2 6	40 1	7 8	15	58	9	430	10	20	1 7	24
b	½ peeled avocado, (3½ by 3¼ in diam, 114 gm)	279	1 9	30 1	5 8	11	43	7	330	07	15	1 3	18

31	Bacon, medium fat, broiled or fried, drained												
a	1 pound	2,761	114	250	5	114	1,158	15.0	(0)	2.16	1.41	21.8	0
b	2 slices (16 gm)	97	4	8.8	.2	4	41	.5	(0)	.08	.05	.8	0
33	Bacon, Canadian, raw, 4 ounces	262	25.1	17.0	(.3)	15	238	3.7	(0)	1.04	.28	5.0	0
34	Bananas, raw, *refuse, skins, 33%*												
a	1 large (8 by 1½ in, 200 gm)	119	1.6	.3	31	11	38	.8	570	.06	.06	1.0	13
b	1 medium (6 by 1½ in, 150 gm)	88	1.2	.2	23	8	28	.6	420	.04	.05	.7	10
c	1 cup slices, E.P. (154 gm)	136	1.8	.3	35	12	43	.9	660	.07	.07	1.1	15
35	Barley, pearled, light, dry, 1 cup (203 gm)	708	16.6	2.0	160.0	32	384	(4.1)	(0)	.25	.17	6.3	(0)
	Beans, *common or kidney, mature* dry seeds												
	Red kidney												
38	Canned (or cooked) solids and liquid, 1 cup (256 gm)	230	14.6	1.0	42.0	102	317	4.9	(0)	.12	.12	2.0	(0)
	Other (including navy, pea bean *white marrow other*)												
39	Raw 1 cup (190 gm)	642	40.7	3.0	117.0	310	830	13.1	0	1.28	.44	4.1	3
	Canned baked												
40	Pork and molasses 1 cup (261 gm)	325	15.1	7.8	50.1	146	295	5.5	90	.13	.09	1.2	7
41	Pork and tomato sauce 1 cup 261 gm)	295	15.1	5.5	48.0	107	295	4.7	220	.13	.09	1.2	7
	Beans, Lima												
	Immature seeds												
43	Cooked												
a	1 pound	432	22.7	1.8	83.1	132	350	7.7	1,320	.64	.41	5.0	68
b	1 cup (160 gm)	152	8.0	.6	29.3	46	123	2.7	460	.22	.14	1.8	24
	Canned												
44	Solids and liquid, 1 cup (249 gm)	176	9.5	.7	33.6	67	182	4.2	330	.09	.11	1.3	20
45	Drained solids												
a	1 pound	432	22.7	1.8	83.1	132	350	7.7	830	.13	.25	2.3	27
b	1 cup (160 gm)	152	8.0	.6	29.3	46	123	2.7	290	.04	.09	.8	9
47	Mature dry seeds, 1 cup (183 gm)	610	37.9	2.4	112.7	124	697	13.7	0	.98	.32	3.6	3

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1]Data on proximate constituents appl...

TABLE 138—CONT D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Beans, snap												
	Green												
49	Cooked (small amount of water, short time)												
a	1 pound	99	6 4	9	21 3	163	104	3 2	3,000	32	45	2 3	64
b	1 cup (125 gm)	27	1 8	2	5 9	45	29	9	830	09	12	6	18
50	Cooked (large amount of water, long time)												
a	1 pound	99	6 4	9	21 3	163	104	3 2	3,000	23	41	1 8	45
b	1 cup (125 gm)	27	1 8	2	5 9	45	29	9	830	06	11	5	12
	Canned												
51	Solids and liquid, 1 cup (239 gm)	43	2 4	2	10 0	65	45	3 3	990	08	10	.7	9
52	Drained solids												
a	1 pound	99	6 4	9	21 3	163	104	7 7	2,270	16	25	1 8	25
b	1 cup (125 gm)	27	1 8	2	5 9	45	29	2 1	620	04	07	5	7
53	Strained (infant food), 1 ounce	6	5	0	1 3	9	7	2	140	01	02	1	1
	Wax or yellow												
	Canned												
56	Solids and liquid, 1 cup (239 gm)	43	2 4	2	10 0	65	45	3 3	230	08	10	7	9
57	Drained solids												
a	1 pound	99	6 4	9	21 3	163	104	7 7	540	16	25	1 8	25
b	1 cup (125 gm)	27	1 8	2	5 9	45	29	2 1	150	04	07	5	7
	Beans, soya See Soybeans												
	Bean soup See Soups												
	Bean sprouts, raw See Mung bean and Soybean sprouts												

	Beef cuts cooked												
64	Chuck[1]												
a	1 pound with bone	1 140	96	81	0	40	131	11 4	(0)	18	[illegible]	17 2	0
b	1 pound without bone	1 406	118	100	0	70	31	14 1	(0)	22	93	18 7	0
c	3 ounces without bone	[illegible]	29	19	0	9	100	2 [illegible]	(0)	04	17	3 5	0
66	Flank[1]												
a	1 pound with bone	1 381	110	101	0	48	313	13 2	(0)	22	89	18 0	0
b	1 pound without bone	1 425	114	104	0	70	331	13 [illegible]	(0)	2	92	18 6	0
c	3 ounces without bone	270	21	20	0	9	100	2 6	(0)	04	17	3 5	0
68	Hamburger												
a	1 pound	1 [illegible]4	100	136	0	41	717	12 7	(0)	35	85	21 8	0
b	3 ounces	316	19	26	0	8	134	2 4	(0)	07	16	4 1	0
	Lean See Round												
70	Porterhouse												
a	1 pound with bone	1 [illegible]9	86	100	0	41	632	11 2	(0)	21	68	17 3	0
b	1 pound without bone	1 5[illegible]4	104	123	0	70	772	13 [illegible]	(0)	[illegible]	81	21 1	0
c	3 ounces without bone	213	20	23	0	[illegible]	145	2 [illegible]	(0)	05	15	4 0	0
72	Rib roast												
a	1 pound with bone	1 050	79	79	0	33	612	[illegible]	(0)	21	60	14 2	0
b	1 pound without bone	1 449	109	109	0	45	840	13 [illegible]	(0)	28	82	19 5	0
c	3 ounces without bone	268	20	20	0	9	157	2 [illegible]	(0)	05	15	3 6	0
74	Round												
a	1 pound with bone	917	107	51	0	43	885	13 4	(0)	30	86	21 8	0
b	1 pound without bone	1 057	123	59	0	50	1 017	15 4	(0)	35	99	25 1	0
c	3 ounces without bone	197	23	11	0	9	191	2 [illegible]	(0)	06	19	4 7	0
76	Rump[1]												
a	1 pound with bone	1 371	65	99	0	25	263	[illegible]	(0)	13	48	9 6	0
b	1 pound without bone	1 714	95	145	0	36	386	11 4	(0)	19	70	14 1	0
c	3 ounces without bone	320	18	27	0	7	72	2 1	(0)	04	13	2 6	0
78	Sirloin												
a	1 pound with bone	1 173	91	87	0	40	691	11 5	(0)	26	74	18 8	0
b	1 pound without bone	1 346	104	100	0	45	794	13 2	(0)	30	85	21 7	0
c	3 ounces without bone	257	20	19	0	9	149	2 5	(0)	06	16	4 1	0
	Beef canned												
79	Corned beef hash 3 ounces	120	11 7	5 2	6 1	22	124	1 1	Trace	02	11	2 4	0
80	Roast beef 3 ounces	189	21	11	0	14	99	2 0	(0)	02	19	3 6	0
81	Strained (infant food) 1 ounce	30	4 9	1 0	0	3	43	1 2	(0)	Trace	06	9	0

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1] Data assume cut to be prepared by braising or pot roasting Use of proportionate quantity of drippings would add approximately 50% more thiamine and niacin and 25% more riboflavin

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG.	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Beef, corned, canned												
83	Lean, 3 ounces	159	22 5	7	0	18	94	3 8	(0)	01	21	3 0	0
84	Medium fat, 3 ounces	182	21 5	10	0	17	90	3 7	(0)	01	20	2 9	0
85	Fat, 3 ounces	221	20 0	15	0	16	83	3 4	(0)	01	19	2 7	0
86	Beef, dried or chipped												
a	1 cup (165 gm)	336	56 6	10 4	0	33	667	8 4	(0)	(12)	(53)	(6 3)	0
b	2 ounces	115	19 4	3 6	0	11	229	2 9	(0)	(04)	(18)	(2 2)	0
87	*Beef and vegetable stew												
a	1 pound	487	25 0	37 2	32 2	59	340	5 0	4,870	24	29	6 6	28
b	1 cup (235 gm)	252	12 9	19 3	16 7	31	176	2 6	2,520	12	15	3 4	15
88	Beer (average 4% alcohol), 1 cup (240 gm)	[1]	1 4	0	10 6	10	62	0	(0)	Trace	06	4	(0)
	Beets, common red												
89	Raw, peeled root, 1 cup diced (134 gm)	56	2 1	1	12 9	36	58	1 3	30	03	06	6	13
90	Cooked												
a	1 pound	187	4 5	5	44 5	95	141	3 2	90	09	.18	1 4	30
b	1 cup diced (165 gm)	68	1 6	2	16 2	35	51	1 2	30	03	07	5	11
91	Canned, solids and liquid, 1 cup (246 gm)	82	2 2	2	19 4	37	71	1 5	40	02	06	3	12
92	Drained solids												
a	1 pound	187	4 5	5	44 5	95	141	3 2	80	05	.13	5	21
b	1 cup diced (165 gm)	68	1 6	2	16 2	35	51	1 2	30	02	05	2	8
93	Strained (infant food), 1 ounce	10	4	0	2 2	5	7	2	Trace	Trace	01	Trace	2
95	Beet greens, common, cooked												
a	1 pound	125	9 1	1 4	25 4	[1] 536	204	14 5	33,780	23	.73	1 8	68
b	1 cup (145 gm)	39	2 9	4	8 1	[2] 171	65	4 6	10,790	07	23	6	22
	Beverages, carbonated												
96	Ginger ale, 8 fluid ounces (1 cup, 230 gm)	80	--	--	21	--	--	--	--	--	--	--	--

[illegible]	Other including kola type [8] fluid ounces (1 cup, 230 gm)	107			28			-	-	-	--	-	--
	*Biscuits baking powder 1 biscuit (2½ in diam, 38 gm) made with												
98	Unenriched flour	129	3.1	4.0	19.8	83	73	2	0	02	03	2	(0)
99	Enriched flour	129	3.1	4.0	19.8	83	73	7	0	0?	08	7	(0)
100	Enriched self rising flour	127	3.0	4.1	19.0	84	95	7	0	09	09	8	(0)
	Blackberries												
102	Raw, 1 cup (berries about ½ by 1 in 144 gm)	82	1.7	1.4	18.0	46	46	1.3	280	05	06	5	30
	Canned solids and liquid												
103	Water pack, 1 cup (244 gm)	104	2.2	1	22.9	44	46	(1.7	170	03	05	7	15
104	Syrup pack 1 cup (251 gm)	216	1.8	[illegible]	52	45	48	(1.8	140	03	05	5	16
	Black eyed peas See Cowpeas												
105	*Blancmange (vanilla cornstarch pudding)												
a	1 pound	504	15.9	17.7	71.3	531	418	5	720	15	73	4	3
b	1 cup (248 gm)	275	8.7	9.7	38.9	290	228	2	390	08	10	2	2
	Blueberries												
106	Raw, 1 cup (140 gm)	85	8	8	21.1	22	18	1.1	400	(04)	(03)	(4)	23
	Canned solids and liquid												
107	Water pack 1 cup (242 gm)	90	1.0	1.0	21.8	27	15	(1.2	100	03	03	5	32
108	Syrup pack 1 cup (249 gm)	245	1.0	1.0	64.7	27	15	(1.2	100	03	03	5	33
109	Frozen without sugar 3 ounces	52	5	5	12.8	14	11	7	200	(01)	(01)	(2)	12
	Bluefish												
111	Cooked baked												
a	1 pound	704	124.4	19.1	0	104	1,330	3.2		58	51	10.0	--
b	1 piece (3½ by 3 by ½ in 125 gm)	193	34.2	5.2	0	29	366	9		15	14	2.8	
112	Cooked, fried												
a	1 pound	929	103.1	44.5	21.3	86	1,103	2.7	--	49	48	9.1	
b	1 piece (3½ by 3 by ½ in, 150 gm)	307	34.0	14.7	7.0	28	364	9		16	16	3.1	--

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[8]The value excluding energy derived from alcohol is 48 calories If the energy from alcohol is considered available the value is 114 calories

Calcium may not be available because of presence of oxalic acid

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL.	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG.	NIACIN MG	ASCORBIC ACID MG
	Bologna See Sausage												
	Boston brown bread See Breads												
113	Bouillon cubes, 1 cube (5/8 in, 4 gm)	2	(2)	1	(0)	--	--	--	--	--	07	1 0	0
114	Brains, all kinds, raw, 3 ounces	106	8 8	7 3	7	14	281	3 1	0	20	22	3 8	15
115	Bran (breakfast cereal, almost wholly bran), 1 cup (60 gm)	145	7 2	2 0	44 5	56	787	6 2	(0	22	23	11 5	(0)
116	Bran flakes (40% bran), 1 cup (40 gm)	117	4 3	8	31 5	24	249	2 0	(0)	19	09	3 5	(0)
117	Bran, raisin, 1 cup (50 gm)	149	4 5	9	39 3	30	270	2 4	(0)	19	09	3 5	(0)
118	Brazil nuts												
a	Shelled, 1 cup (32 kernels, 140 gm)	905	20 2	92 3	15 4	260	970	4 8	Trace	1 21	--	--	--
b	In shell, 1 cup (14 nuts, 122 gm)	394	8 8	40 2	6 7	113	423	2 1	Trace	53	--	--	--
	*Breads												
	Boston brown bread made with degermed corn meal, 1 slice (3 by 3/4 in, 48 gm)												
119	Unenriched	105	2 3	1 0	22 1	89	76	1 2	70	04	06	.7	(0)
120	Enriched	105	2 3	1 0	22 1	89	76	1 4	70	06	08	9	(0)
	Cracked wheat bread, 1 slice (1/2 in thick, 23 gm), made with												
121	Unenriched flour	60	2 0	5	11 8	19	29	2	0	03	02	3	(0)
122	Toasted, 1 slice	60	2 0	5	11 8	19	29	2	0	02	02	3	(0)
123	Enriched flour	60	2 0	5	11 8	19	29	5	0	.06	04	6	(0)
124	Toasted, 1 slice	60	2 0	5	11 8	19	29	5	0	05	04	6	(0)
	French or Vienna breads, 1 pound												
125	Unenriched	1,225	36 8	12 3	236 1	109	322	3 2	0	21	28	4 2	(0)
126	Enriched	1,225	36 8	12 3	236 1	109	322	8 0	0	1 1	7	10 0	(0)

	Italian bread 1 pound											
127	Unenriched	119	39.7	3.6	243.8	9	370	3.2	0	.23	.30	1.5	(0)
128	Enriched[1]	119	39.7	3.6	243.8	9	370	8.0	0	1.1	.7	10.0	(0)
	Raisin bread 1 slice (½ in thick 23 gm)											
129	Unenriched	65	1.6	.7	13.3	18	24	.3	Trace	.02	.02	.2	(0)
130	Toasted 1 slice	65	1.6	.7	13.3	18	24	.3	Trace	.01	.02	.2	(0)
131	Enriched[1]	65	1.6	.7	13.3	18	24	.4	Trace	.06	.04	.5	(0)
132	Toasted 1 slice	65	1.6	.7	13.3	18	24	.4	Trace	.04	.04	.5	(0)
133	Rye bread American (⅓ rye ⅔ clear flour) 1 slice (½ in thick 23 gm)	[illegible]	2.1	.3	12.1	17	34	.4	0	.04	.02	.4	(0)
	White bread unenriched 1 slice (½ in thick 23 gm)											
134	2% nonfat milk solids	64	1.9	.8	12.0	15	19	.1	0	.01	.02	.2	(0)
135	4% nonfat milk solids[2]	63	2.0	.7	11.9	18	21	.1	0	.01	.02	.2	(0)
136	Toasted 1 slice	63	2.0	.7	11.9	18	21	.1	0	.01	.02	.2	(0)
137	6% nonfat milk solids	63	2.0	.7	12.0	21	23	.1	0	.01	.03	.2	(0)
	White bread enriched 1 slice (½ in thick 23 gm)											
138	2% nonfat milk solids	64	1.9	.8	12.0	15	19	[1].4	0	[1].06	[1].04	[1].5	(0)
139	4% nonfat milk solids[2]	63	2.0	.7	11.9	18	21	[1].4	0	[1].06	[1].04	[1].5	(0)
140	Toasted 1 slice	63	2.0	.7	11.9	18	21	.4	0	.04	.04	.5	(0)
141	6% nonfat milk solids	63	2.0	.7	12.0	21	23	[1].4	0	[1].06	[1].04	[1].5	(0)
142	Whole wheat bread 1 slice (½ in thick 23 gm)	55	2.1	.6	11.3	22	60	.5	0	.07	.03	.7	(0)
143	Toasted 1 slice	55	2.1	.6	11.3	22	60	.5	0	.05	.03	.7	(0)
	See also Biscuits Corn bread Muffins Rolls											
144	Bread crumbs dry grated 1 cup (88 gm)	329	10.5	4.0	63.8	98	114	2.3	0	.24	.19	2.7	(0)
	Breakfast foods mixed cereals											
145	Corn and soy grits ready to eat (added thiamine and niacin) 1 cup (50 gm)	177	9.0	.2	37.6	33	91	3.2	(0)	.34	.06	1.0	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1]Iron thiamine riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity of breads proposed by the Federal Security Agency and published in the Federal Register August 3 1943

[2]When the amount of nonfat milk solids in commercial bread is unknown use bread with 4% nonfat milk solids item 135 for unenriched bread and 139 for enriched

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Breakfast foods, mixed cereals—Cont'd												
146	Wheat and malted barley, ready to eat (added thiamine and niacin), 1 cup (105 gm)	379	11 6	6	86 9	49	346	3 7	(0)	56	18	4 9	(0)
	Breakfast foods See individual grain, as Corn, Oatmeal, etc												
	Broccoli												
148	Cooked, flower stalks												
a	1 pound	133	15 0	9	25 0	590	345	5 9	15,440	32	68	3 6	336
b	1 cup (150 gm)	44	5 0	3	8 2	195	114	2 0	5,100	10	22	1 2	111
	Brown Betty See Apple Betty												
151	Brussels sprouts, cooked												
a	1 pound	212	20 0	2 3	40 4	154	354	5 9	1,820	18	54	2 3	213
b	1 cup (130 gm)	60	5 7	6	11 6	44	101	1 7	520	05	16	6	61
	Buckwheat flour												
153	Dark, 1 cup sifted (98 gm)	326	11 5	2 4	70 6	32	340	2 7	(0)	56	15	2 8	(0)
154	Light, 1 cup sifted (98 gm)	340	6 3	1 2	77 9	11	86	1 0	(0)	08	(04)	(4)	(0)
	Buckwheat pancake mix See Pancake mix												
155	Butter												
a	1 cup (224 gm)	1,604	1 3	181 4	9	45	36	0	[1] 7,390	--	--	--	--
b	1 tablespoon (14 gm)	100	1	11 3	1	3	2	0	[1] 460	--	--	--	--
c	1 pat or square (64 per lb, 7 gm each)	50	0	5 7	0	1	1	0	[1] 230	--	--	--	--
156	Buttermilk, cultured (made from skim milk)												
a	1 quart (976 gm)	348	34 2	1 0	49 8	(1,152)	908	7	40	35	43	1 1	13
b	1 cup (244 gm)	86	8 5	2	12 4	(288)	227	2	10	09	1 74	3	3

157	Cabbage Raw, F P											
a	1 round, trimmed	109	6.4	9	24.1	209	141	2.3	370	27	24	1.4	[illegible]
b	1 wedge (3½ by 4½ in, 100 gm)	24	1.4	2	5.3	46	31	5	80	06	05	3	70
c	1 cup shredded finely (100 gm)	24	1.4	2	5.3	46	31	5	80	06	05	3	70
158	Cooked (small amount of water short time)												
a	1 pound	109	6.4	9	24.1	209	141	2.3	410	23	23	1.4	141
b	1 cup (170 gm)	40	2.4	3	9.0	78	53	8	150	08	08	5	53
159	Cooked (large amount of water long time)												
a	1 pound	109	6.4	9	24.1	209	141	2.3	410	14	14	9	86
b	1 cup (170 gm)	40	2.4	3	9.0	78	53	8	170	05	05	3	32
	Cabbage salad See Coleslaw												
	Cabbage celery or Chinese												
161	Raw 1 cup leaves and stem (1 in pieces 100 gm	14	1.2	3	2.4	43	41	9	2[illegible]0	03	04	4	31
162	Cooked												
a	1 pound	64	5.4	1.4	10.9	19[illegible]	186	4.1	1 180	09	14	1.4	100
b	1 cup (190 gm	27	2.3	6	4.6	82	78	1.7	490	04	06	6	42
	*Cakes												
163	Angel food 2 inch sector (1/12 of 8 in diam 40 gm)	108	3.4	1	23.5	2	10	1	0	Trace	05	1	(0)
164	Foundation 1 square (3 by 2 by 1¾ in 65 gm)	228	3.8	7.6	36.3	82	78	3	[2] 100	02	05	2	(0)
165	Foundation plain icing												
a	3 inch sector of layer cake (1/8 of 6 in diam 90 gm)	308	4.5	8.4	54.4	91	86	4	[2] 110	02	06	2	(0)
b	2 inch sector of layer cake (1/16 of 10 in diam 120 gm)	410	6.0	11.2	72.5	121	115	5	[2] 150	03	08	2	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1]Year round average

[2]If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 350 I U per square item 164 390 I U per 3 inch sector iced items 165a and 166a and 520 I U per 2 inch sector iced items 165b and 166b

BLE 138—CONT'D

FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD EN ERGY CAL	PRO TEIN GM	FAT GM	TOTAL CARBO HY DRATE GM	CAL CIUM MG	PHOS PHO RUS MG	IRON MG	VITA MIN A VALUE I U	THIA MINE MG	RIBO FLAVIN MG	NIACIN MG	ASCOR BIC ACID MG
*Cakes—Cont'd												
Foundation fudge icing												
3 inch sector of layer cake (1/6 of 6 in diam, 90 gm)	314	4 0	10 4	52 6	88	91	4 [1]	110	02	07	2	(0)
2 inch sector of layer cake (1/16 of 10 in diam, 120 gm)	419	5 3	13 8	70 2	118	121	5 [1]	140	03	10	3	(0)
Fruit, dark												
1 piece (2 by 2 by ½ in, 30 gm)	106	1 6	4 1	16 8	29	38	8 [2]	50	04	04	3	(0)
Plain cake and cupcakes												
1 square (3 by 2 by ½ in, 55 gm)	180	3 5	4 5	31 4	85	75	2 [3]	70	02	05	2	(0)
1 cupcake (2¾ in diam, 40 gm)	131	2 6	3 3	22 8	62	55	2 [3]	50	01	03	1	(0)
1 cupcake (1¾ in diam) or 1 square (2 by 2 by 1 in, 25 gm)	81	1 6	2 0	14 2	39	34	1 [3]	30	01	02	1	(0)
Plain cake and cupcakes, iced												
3 inch sector of layer cake (1/6 of 6 in diam, 75 gm)	241	3 9	4 6	46 6	88	78	3 [3]	70	02	05	2	(0)
2 inch sector of layer cake (1/16 of 10 in diam, 100 gm)	322	5 2	6 2	62 1	117	104	4 [3]	90	02	07	2	(0)
cupcake (2¾ in diam, 50 gm)	161	2 6	3 1	31 0	58	52	2 [3]	50	01	04	1	(0)
cupcake (1¾ in diam) or 1 square (2 by 2 by 1 in, 40 gm)	129	2 1	2 5	24 8	47	42	2 [3]	40	01	03	1	(0)
nd												
slice (2¾ by 3⅞ in, 30 gm)	130	2 1	7 0	14 8	16	31	5 [4]	100	04	05	3	(0)
square (3 by 2 by 2 in, 75 gm)	204	3 8	13 3	40 6	79	85	4 [5]	160	02	06	2	(0)

1 –	Rich plain icing												
a	3 inch sector of layer cake ($1/6$ of 6 in diam, 100 gm)	378	4 4	11 7	58 2	88	94	5	[6] 170	02	07	2	(0)
b	2 inch sector of layer cake ($1/16$ of 10 in diam 130 gm)	491	5 7	19 1	75 7	114	122	6	[6] 220	03	10	2	(0)
173	Sponge 2 inch sector ($1/12$ of 8 in diam 40 gm)	117	3 2	2 0	21 8	11	44	6	210	02	06	1	(0)
	Candy												
	Candied or glacé peel												
174	Citron, 1 ounce	89	1	1	22 7	24	7	2	-	--	--	-	--
175	Ginger root crystallized 1 ounce	97	1	1	24 7					-	-	-	--
176	Lemon, orange or grapefruit peel 1 ounce	90	1	1	22 9					-	--	-	-
177	*Butterscotch 1 ounce	116	0	2 5	21 3	6	2	5	(0)	(0)	Trace	Trace	(0)
178	*Carmels 1 ounce	118	8	3 3	22 0	36	26	7	50	01	04	Trace	Trace
179	Chocolate sweetened milk 1 ounce	143	2	9 5	15 8	61	80	3	10	03	11	2	(0)
180	Chocolate sweetened milk with almonds 1 ounce	151	2 3	10 9	14 2	58	71	6	10	04	14	(3)	(0)
181	Chocolate creams 1 ounce	110	1 1	4 0	20					-	--		(0)
182	Fondant 1 ounce	101	0	0	26	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
183	*Fudge plain 1 ounce	116	5	3 2	23 0	[7] 14	19	1	10	Trace	02	Trace	Trace
184	Hard 1 ounce	108	0	0	28	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
185	Marshmallows 1 ounce	92	9	0	23	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)
186	*Peanut brittle 1 ounce	125	2 4	4 4	20 6	11	35	6	10	03	01	1 4	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1] If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 350 I U per square item 164 390 I U per 3 inch sector iced items 165a and 166a and 5 9 I U per inch sector iced items 165b and 166b

[2] If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 120 I U

[3] If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 200 I U per large square, item 168a 150 I U per cupcake item 168b 90 I U per small cupcake or square item 168c 210 I U per 3 inch sector iced item 169a 280 I U per 2 inch sector iced item 169b 140 I U per cupcake iced item 169c and 110 I U per small cupcake or square iced item 169d

[4] If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 300 I U

[5] If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 690 I U per square item 171

[6] If the fat used in the recipe is butter or fortified margarine the vitamin A value would be 690 I U per 3 inch sector iced item 172a and 900 I U per 2 inch sector iced item 172b

[7] If the calcium contributed by chocolate is considered unavailable the value would be 11 mg per ounce

TABLE 138—CONT D

	FOOD DESCRIPTION AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
187	Cantaloups raw												
a	½ melon (5 in diam 385 gm) refuse rind and cavity contents 53%	37	1 1	4	8 3	31	29	7	16 190	09	07	9	59
b	1 cup diced (145 gm)	30	9	3	6 7	25	23	6	14 960	07	05	7	47
	Carrots												
188	Raw												
a	1 carrot (5½ by 1 in or 25 thin strips 50 gm)	21	6	2	4 6	20	18	4	6 000	03	03	3	3
b	1 cup grated (110 gm)	45	1 3	3	10 2	43	41	9	13 200	06	06	7	7
189	Cooked 1 cup diced (145 gm)	44	9	7	9 3	38	38	9	18 130	07	07	7	6
	Canned												
190	Solids and liquid 1 cup diced (246 gm)	69	1 2	1 0	15 0	54	59	1 5	29 520	06	05	8	6
191	Drained solids												
a	1 pound	138	2 7	2 3	29 1	118	118	2 7	79 750	10	10	1 4	12
b	1 cup diced (145 gm)	44	9	7	9 3	38	38	9	25 470	03	03	4	4
192	Strained (infant food) 1 ounce	7	3	0	1 7	7	7	2	2 530	01	01	1	1
194	Cashew nuts roasted or cooked 1 ounce	164	5 2	13 7	7 7	13	121	1 4		18	05	6	
	Catsup tomato See Tomato catsup												
	Cauliflower												
195	Raw 1 cup flower buds (100 gm)	25	2 4	2	4 9	22	72	1 1	90	11	10	6	69
196	Cooked												
a	1 pound	113	10 9	9	22 2	100	327	5 0	410	27	36	2 3	127
b	1 cup (120 gm)	30	2 0	2	5 9	26	86	1 3	108	07	10	6	34

	Celery, bleached												
198	Raw												
a	3 small inner stalks (5 in long ¾ in wide 50 gm)	9	6	1	1 8	25	20	2	0	03	02	2	4
b	1 large outer stalk (8 in long, 1 in wide, 1½ in at root end, 40 gm)	7	5	1	1 5	20	16	2	0	02	02	2	3
c	1 cup diced (100 gm)	18	1 3	2	3 7	50	40	5	0	05	04	4	7
199	Cooked												
a	1 pound	82	5 9	9	16 8	227	182	2 3	0	18	14	1 4	23
b	1 cup diced (130 gm)	24	1 7	3	4 8	65	52	6	0	05	04	4	6
200	Cereal foods (infant food), dry precooked 1 ounce See also Oatmeal (infant food)	103	4 0	-	20 8	185	104	9 6	(0)	31	13	[2] 1 3	(0)
	Chard												
202	Leaves and stalks cooked												
a	1 pound	94	6 4	9	20 0	[3] 477	163	11 4	14 120	18	27	1 8	77
b	1 cup (145 gm)	30	2 0	3	6 4	[3] 152	52	3 6	4 510	06	09	6	25
204	Leaves cooked												
a	1 pound	122	11 8	1 8	21 8	[3] 477	163	11 4	43 000	18	73	1 4	77
b	1 cup (175 gm)	47	4 6	-	8 4	[3] 184	63	4 4	16 000	07	28	5	70
	Cheese												
205	Blue mold domestic type 1 ounce	104	6 1	8 6	6	89	98	(1)	(350)	01	17	1	(0)
206	Camembert 1 ounce	85	5 0	7 0	5	30	52	1	(290)	01	21	3	(0)
207	Cheddar												
a	1 cup (112 gm)	440	28 0	36 1	2 4	812	534	1 1	1 570	03	47	Trace	(0)
b	1 ounce	113	7 1	9 1	6	206	140	3	400	01	12	Trace	(0)
208	Cheddar processed 1 ounce	105	6 6	8 5	5	191	[4] 223	3	(370)	Trace	12	(Trace)	(0)
209	Cheese foods cheddar 1 ounce	92	5 9	6 8	2 0	162	226	2	(303)	(01)	16	Trace	(0)
210	Cottage from skim milk												
a	1 cup (225 gm)	215	43 9	1 1	4 5	216	425	7	(50)	04	69	(2)	(0)
b	1 ounce	27	5 5	1	6	27	54	1	(10)	01	09	(Trace)	(0)
211	Cream cheese												
a	1 ounce	106	2 6	10 5	6	19	27	1	(410)	(Trace)	06	Trace	(0)
b	1 tablespoon (15 gm)	56	1 4	5 6	3	10	15	0	(220)	(Trace)	03	Trace	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1] Vitamin A based on deeply colored varieties

[2] Based on products ranging from 0 7 to 1 9 mg per ounce The niacin value of some products is as high as 6 5 mg

[3] Calcium may not be available because of presence of oxalic acid

[4] 130 mg if the added emulsifying agent does not contain phosphorus

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Cheese—Cont'd												
212	Limburger, 1 ounce	97	6 0	7 9	6	167	111	2	360	02	14	Trace	(0)
213	Parmesan, 1 ounce	112	10 2	7 4	8	329	233	1	(300)	01	21	1	(0)
214	Swiss, 1 ounce	105	7 8	7 9	5	262	160	3	410	Trace	(11)	(Trace)	(0)
215	Swiss, processed, 1 ounce	101	7 5	7 6	5	251	1 246	3	390	Trace	11	Trace	(0)
216	Cherries, sour, sweet, and hybrid, raw												
a	1 cup, refuse, pits, 6% (114 gm)	65	1 2	5	15 8	19	21	4	710	05	06	4	9
b	1 cup, pitted (154 gm)	94	1 7	8	22 8	28	31	6	960	08	09	6	13
217	Cherries, red, sour, pitted, canned, 1 cup (254 gm)	122	2 0	8	30 2	28	30	(8)	1,840	07	04	4	14
	Chicken[2]												
	Raw												
218	Broilers, ½ bird (8 oz, bone out)	332	44 4	15 8	0	31	440	3 3	(0)	18	36	22 4	(0)
219	Roasters (4 oz, bone out)	227	22 9	14 3	0	16	227	1 7	(0)	09	.18	9 1	(0)
220	Hens, stewing chickens (4 oz, bone out)	342	20 4	28 3	0	16	227	1 7	(0)	09	18	9 1	(0)
	Fryers												
	Cut up pieces (commercial cut)												
221	1 breast (8 oz bone out)	210	47 0	1 0	0	28	428	2 2	(0)	13	18	21 1	(0)
222	1 leg (5 oz, bone out)	159	29 1	3 8	0	21	266	2 6	(0)	14	34	8 0	(0)
223	Canned, boned, 3 ounces	169	25 3	6 8	0	12	126	1 5	(0)	03	14	5 4	(0)
	Chicken broth See Soups, canned bouillon, broth, and consomme												
	Chicken soup See Soups, canned, chicken												

	Chick peas or garbanzos dry whole seed												
224	Raw, 1 cup (210 gm)	7 5	43 7	9 9	1_7 9	193	7 89	14 9	Trace	1 16	37	3 2	(4)
225	*Chile con carne* (without beans) canned,[3] ½ cup (8 gm)	170	8 8	12 6	4 9	32	129	1 2	130	01	10	1 1	-
226	Chili sauce												
a	1 cup (273 gm)	_68	7 6	1 1	64 7	(33)	(49)	(2 2	(5 130)	(25)	(19)	(6 1)	(31)
b	1 tablespoon (17 gm)	17	5	1	4 0	(2)	(3)	(1)	(3_0)	(02)	(01)	(4)	(2)
	Chocolate												
227	Bitter or unsweetened												
a	1 ounce	143	1 6	15 0	4 8 3	5 28	1 6	1 2	_0	01	06	3	(0)
b	1 cup grated (132 gm)	66	7 3	69 8	4 38 5	5 129	7 80	5 8	80	06	32	1 3	(0)
	Sweetened												
228	Plain 1 ounce	133	6	8 4	17 8	5 (18	81)	8	(10)	(01)	(04)	(2)	(0)
	Milk See Candy												
	Milk with *almonds* See Candy												
229	*Chocolate beverage made with milk 1 cup (_50 gm	_39	8 2	1	26 2	_40	2 0	5	7 0	08	40	3	2
230	Chocolate syrup 1 tablespoon (20 gm)	42	(2	-	11 3	(3	(17)	(3		-		--	
	Cider See Apple juice												
	Citron See Candy												
	Clams long and round												
231	Raw meat only 4 ounces	9	14 5	1 6	3 9	(109)	(1 8)	(7 9)	120	11	_0	(1 8)	--
232	Canned solids and liquid 3 ounces	44	6 7	9	1 8	74	106	5 4	(70)	(04)	08	9	

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value
[1]153 mg if the added emulsifying agent does not contain phosphorus
[2]Vitamin values based on muscle meat only
[3]Not less than 60% meat not more than 8% cereals seasoning
[4]Approximately one third of this total amount of carbohydrate calculated by difference is starch and sugar The remaining portion is made up of materials thought to be utilized only poorly *if at all by the body*
[5]Calcium may not be available because of presence of oxalic acid

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
233	Cocoa, breakfast, plain, dry powder												
a	1 cup, stirred before measuring (112 gm)	334	(9.0)	26.7	[1] 54.8	[2] 140	797	13.0	(30)	.14	.43	2.6	(0)
b	1 ounce	84	(2.3)	6.7	[1] 13.9	[2] 35	202	3.3	(10)	.03	.11	.7	(0)
c	1 tablespoon (7 gm)	21	(.6)	1.7	[1] 3.4	[2] 9	50	.8	(Trace)	.01	.03	.2	(0)
234	*Cocoa beverage, made with all milk, 1 cup (250 gm)	236	9.5	11.5	27.2	298	285	1.0	400	.10	.46	.5	3
	Coconut												
235	Fresh, meat												
a	1 cup shredded (97 gm)	349	3.3	33.7	13.6	20	95	1.9	0	.09	.01	.2	2
b	1 piece (2 by 2 by ½ in, 45 gm)	161	1.5	15.6	6.3	9	44	.9	0	.04	Trace	.1	1
236	Dried, shredded (sweetened)												
a	1 cup (62 gm)	344	2.2	24.2	33.0	27	118	2.2	0	Trace	Trace	Trace	(0)
b	4 ounce package	629	4.1	44.2	60.1	49	216	4.1	0	Trace	Trace	Trace	(0)
237	Milk only, 1 cup (240 gm)	60	.7	1.0	12.0	58	70	.2	0	Trace	Trace	.2	4
	Cod												
238	Raw, 4 ounces E P.	84	18.7	.5	0	11	220	.5	0	.07	.10	2.5	2
239	Dried, 1 ounce	106	23.2	.8	0	(14)	253	1.0	0	.02	.13	3.1	(0)
240	*Coleslaw, 1 cup (120 gm)	102	1.6	7.3	9.2	47	32	.5	80	.06	.05	.3	50
	Collards, cooked.												
242	Boiled in small or moderate amount of water until tender.												
a	1 pound	182	17.7	2.7	32.7	1,130	263	7.3	34,640	.36	1.09	7.7	200
b	1 cup (190 gm.)	76	7.4	1.1	13.7	473	110	3.0	14,500	.15	.46	3.2	84
243	Boiled in large amount of water a long time												
a	1 pound	182	17.7	2.7	32.7	1,130	263	7.3	34,640	.32	.95	6.4	150
b	1 cup (190 gm)	76	7.4	1.1	13.7	473	110	3.0	14,500	.13	.40	2.7	63

Condensed milk See Milk cow												
244 Cookies plain and assorted												
a 1 cooky (3 in diam ½ in thick, 25 gm)	109	1 5	3 2	19 8	6	16	2	(0)	01	01	1	(0)
b 2 wafers (2¼ in diam 10 gm)	44	6	1 3	7 5	3	6	1	(0)	Trace	Trace	Trace	(0)
Cooking oil See Oils salad or cooking												
Corn, sweet, white or yellow												
246 Cooked												
a 1 pound kernels	384	12 3	3 2	91 7	23	236	2 7	[3]1 770	30	15	6 4	36
b 1 cup kernels (165 gm)	140	4 5	1 2	33 3	8	86	1 0	[3] 640	18	16	2 3	13
c 1 ear (5 in long 1¾ in diam 140 gm)	84	2 7	7	20 0	5	51	6	[3] 390	11	10	1 4	8
Canned												
247 Solids and liquid 1 cup (250 gm)	170	5 1	1 3	41 2	10	131	1 3	[3] 520	07	13	2 4	11
248 Drained solids												
a 1 pound	384	12 3	3 2	91 7	23	236	2 7	[3]1 0 0	15	29	4 1	24
b 1 cup (165 gm)	140	4 5	1 2	33 3	8	86	1 0	[3] 350	06	10	1 5	9
*Corn bread or muffins made with												
250 Whole ground corn meal 1 muffin (2¾ in diam 48 gm	103	3 5	2 7	16 7	68	104	8	[4] 60	07	09	4	(0)
251 Enriched degermed corn meal 1 muffin (2¾ in diam 48 gm)	106	3 2	2 3	17 6	67	74	9	[5] 60	08	11	6	(0)
252 Corn flakes 1 cup (25 gm)	96	2 0	1	21 2	3	14	3	(0)	01	02	4	(0)
253 Corn flakes (added thiamine niacin, and iron) 1 cup (25 gm)	96	2 0	1	21 2	3	14	6	(0)	10	02	6	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1] Approximately one third of this total amount of carbohydrate calculated by difference is starch and sugar The remaining portion is made up of materials thought to be utilized *only poorly* if at all by the body

Calcium may not be available because of presence of oxalic acid

[3] Vitamin A based on yellow corn white corn contains only a trace

[4] Based on recipe using white corn meal if yellow corn meal is used vitamin A value is 160 I U

[5] Based on recipe using white corn meal if yellow corn meal is used vitamin A value is 150 I U

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
254	Corn flour 1 cup sifted (110 gm)	406	8 6	2 9	84 5	7	(196)	2 0	[1] 370	22	06	(1 6)	(0)
	Corn grits, degermed												
	Unenriched												
255	Dry, 1 cup (160 gm)	579	13 9	1 3	125 0	6	117	1 6	[2] 480	21	06	1 8	(0)
256	*Cooked												
a	1 pound	230	5 4	5	49 9	5	45	5	[2] 190	07	.03	8	(0)
b	1 cup (242 gm)	122	2 9	2	26 6	2	24	2	[2] 100	04	.01	4	(0)
	Enriched												
257	Dry, 1 cup (160 gm)	579	13 9	1 3	125 0	6	117	[3] 4 6	[2] 480	[3] 71	[3] 42	[3] 5 6	(0)
258	*Cooked												
a	1 pound	230	5 4	5	49 9	5	45	1 4	[2] 190	20	.15	1 9	(0)
b	1 cup (242 gm)	122	2 9	2	26 6	2	24	7	[2] 100	11	08	1 0	(0)
	Corn meal, white or yellow												
	Whole ground, dry												
259	Unbolted, 1 cup (118 gm)	419	10 9	4 6	87 0	12	302	2 8	[4] 600	45	13	2 4	(0)
260	Bolted, 1 cup (127 gm)	459	11 4	4 3	94 6	8	(226)	2 3	[4] 570	38	10	2 4	(0)
	Degermed, unenriched												
261	Dry, 1 cup (145 gm)	527	11 5	1 7	113 7	9	144	1 6	[4] 430	20	.07	1 5	(0)
262	*Cooked												
a	1 pound	227	5 0	9	48 6	5	64	9	[4] 190	08	03	6	(0)
b	1 cup (238 gm)	119	2 6	5	25 5	2	33	5	[4] 100	04	02	.3	(0)
	Degermed, enriched												
263	Dry, 1 cup (145 gm)	527	11 5	1 7	113 7	9	144	[3] 4 2	[4] 430	[3] 64	[3] 38	[3] 5 1	(0)
264	*Cooked												
a	1 pound	227	5 0	9	48 6	5	64	1 8	[4] 190	26	16	2 2	(0)
b	1 cup (238 gm)	119	2 6	5	25 5	2	33	1 0	[4] 100	14	09	1 1	(0)
265	Self rising, unenriched, dry, 1 cup (118 gm)	401	10 3	4 4	83 5	309	748	2 7	[4] 570	42	.12	2 2	(0)
266	Self rising, enriched, dry, 1 cup (118 gm)	401	10 3	4 4	83 5	309	748	[3] 3 4	[4] 570	[3] 52	[3] 31	[3] 4 2	(0)
	Corn oil See Oils, salad or cooking												
	Corn syrup See Syrup, table blends												

	Corn and soy grits See Breakfast foods mixed cereals												
	Cornstarch See Starch												
	Cornstarch pudding See Blanc mange												
	Cottonseed oil See Oils salad or cooking												
	Cowpeas												
208	Immature seed cooked												
a	1 pound	429	32.2	2.7	72.2	168	866	11.4	1770	1.32	36	3.6	91
b	1 cup (160 gm)	151	11.4	1.0	25.4	59	291	4.0	620	46	13	1.3	32
209	Mature seeds dry 1 cup (200 gm)	684	45.8	2.8	123.2	154	902	13.1	60	1.94	22	4.5	3
	Crabs Atlantic and Pacific hard shell												
272	Canned or cooked meat only 3 ounces	89	14.4	2.5	1.1	38	175	8		(04)	(05)	(2.1)	
	Crackers												
273	Graham 4 small or 2 medium (14 gm)	55	1.1	1.4	10.4	3	28	3	(0)	01	01	2	(0)
274	Saltines 2 crackers (2 in square 8 gm)	34	7	9	5.7	2	7	1	(0)	Trace	Trace	1	(0)
275	Soda plain												
a	2 crackers ($2\frac{1}{2}$ in square 11 gm)	47	1.1	1.1	8.0	2	11	1	(0)	01	01	1	(0)
b	1 cup oyster crackers 1 ounce	119	2.7	2.7	20.6	6	27	3	(0)	02	01	3	(0)
c	10 oyster crackers or 1 tablespoon cracker meal (10 gm)	43	1.0	1.0	7.3	2	10	1	(0)	01	Trace	1	(0)
	Cracker meal See Crackers soda												
276	Cranberries raw 1 cup (113 gm)	54	5	8	12.8	16	12	7	50	03	(02)	1	13

Note Asterisk indicates that values are *calculated from a recipe* parentheses indicate imputed value

[1]Vitamin A based on yellow corn flour white corn flour contains only a trace

[2]*Vitamin* A based *on* yellow corn *grits* white corn grits contain only a trace

[3]Iron thiamine riboflavin and niacin are based on the minimum level of enrichment specified in standards of identity promulgated under the Food Drug and Cosmetic Act

[4]Vitamin A based on *yellow* corn *meal white corn meal contains* only a trace

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
278	Cranberry sauce, sweetened, canned or cooked, 1 cup (277 gm)	549	3	8	142 4	(22)	(19)	(8)	(80)	(06)	(06)	(3)	5
	Cream												
279	Light table, or coffee												
a	½ pint (240 gm)	489	7 0	48 0	9 6	233	185	.1	1,980	07	34	.2	3
b	1 tablespoon (15 gm)	30	4	3 0	6	15	12	.0	120	Trace	02	Trace	Trace
280	Heavy or whipping:												
a	½ pint (approx 1 pt whipped, 236 gm)	779	5 4	82 6	7 6	184	144	1	3,390	06	26	.1	1
b	1 tablespoon (15 gm)	49	3	5 2	5	12	9	0	220	Trace	02	Trace	Trace
	Cress, garden												
281	Raw, 1 pound E P	186	19 1	6 4	24 1	958	(173)	(13 2)	13,470	49	.75	4 5	396
282	Cooked												
	Boiled in small or moderate amount of water until tender												
a	1 pound	186	19 1	6 4	24 1	958	(173)	(13 2)	14 980	32	68	3 6	177
b	1 cup (180 gm)	73	7 6	2 5	9 5	380	(68)	(5 2)	5,940	13	27	1 4	70
283	Boiled in large amount of water a long time												
a	1 pound	186	19 1	6 4	24 1	958	(173)	(13 2)	14,980	.27	59	3 2	132
b	1 cup (180 gm)	73	7 6	2 5	9 5	380	(68)	(5 2)	5,940	.11	23	1 3	52
284	Cress, water, leaves and stems, raw, 1 pound	84	7 7	1 4	15 0	885	209	9 1	21,450	37	.71	3 6	350
285	Croaker, raw, 4 ounces E P	109	20 2	2 5	0	--	--	--	--	18	07	2 0	--
286	Cucumbers, raw												
a	1 cucumber (7½ by about 2 in, 290 gm)	25	1 4	2	5 5	20	43	6	0	07	09	4	17
b	6 slices, peeled (⅛ in thick center section, 50 gm)	6	4	0	1 4	5	10	2	0	02	02	1	1
	Cucumber pickles See Pickles												

287	Currants red raw, 1 cup (111 gm)	60	1.3	.2	15.0	40	36	1.0	130	.04	--	--	40
288	*Custard, baked												
a	1 pound	518	24.1	24.5	50.8	518	510	2.3	1,740	.21	.89	.4	2
b	1 cup (248 gm)	283	13.1	13.4	27.8	283	295	1.2	940	.11	.49	.2	1
	Custard pie See Pies												
289	Custard pudding, canned strained (infant food), 1 ounce	31	.9	.8	5.2	26	23	.1	( )	Trace	.01	Trace	Trace
	Dandelion greens												
290	Raw, 1 pound E P	200	12.3	3.2	40.0	849	318	14.1	61,970	.85	1.3	(3.8)	113
291	Cooked												
a	1 pound	200	12.3	3.2	40.0	849	318	14.1	48,870	.53	.51	(3.2)	73
b	1 cup (180 gm)	79	4.9	1.3	15.8	337	126	5.6	27,310	.23	.22	(1.3)	29
292	Dates "fresh" and dried 1 cup pitted, cut (178 gm)	505	3.9	1.1	134.2	128	107	3.7	100	.16	.17	3.9	(0)
293	Doughnuts cake type												
a	1 dozen (13½ oz 383 gm	1,626	25.3	80.4	201.8	280	1,035	12.7	520	.61	.70	4.8	(0)
b	1 doughnut (32 gm)	136	2.1	6.7	16.9	23	92	1.2	40	.05	.04	.4	(0)
294	Eels raw 4 ounces E P	183	21.1	10.3	0	20	229	.8	2,010	.31	.42	1.6	--
	Eggs hen, fresh stored, or frozen												
	Raw												
296	Whole												
a	1 medium (54 gm), refuse shell	77	6.1	5.5	.3	26	101	1.3	550	.05	.14	Trace	0
b	1 cup (5 med 243 gm	394	31.1	27.9	1.7	131	510	6.6	2,760	.23	.70	.2	0
297	White												
a	1 egg white (med 31 gm)	15	3.3	0	.2	2	5	.1	(0)	0	.08	Trace	0
b	1 cup (8 med whites, 243 gm)	121	26.2	0	1.9	15	41	.5	(0)	0	.63	(.2)	0
298	Yolk												
a	1 egg yolk (med, 17 gm)	61	2.8	5.4	.1	25	100	1.2	550	.05	.06	Trace	0
b	1 cup (14 med yolks, 243 gm)	878	39.6	77.5	1.7	357	1,424	17.5	7,810	.67	.84	Trace	0

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value
[1]Based on pared cucumber unpared contains about 0.6 mg of iron and 130 I U vitamin A

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Eggs, hen, fresh, stored, or frozen—Cont'd												
	Cooked												
299	Hard cooked												
a	1 pound, refuse, shell, 11%	655	51 7	46 5	2 8	218	848	10 9	4,590	34	1 11	3	0
b	1 egg in shell, refuse, shell, 11% (54 gm)	77	6 1	5 5	3	26	101	1 3	550	04	13	Trace	0
300	*Omelet												
a	1 pound	775	49 9	58 1	10 0	368	881	9 5	4,720	35	1 22	2	0
b	1 egg omelet (62 gm)	106	6 8	7 9	1 4	50	120	1 3	640	05	17	Trace	0
301	Poached												
a	1 pound	729	57 7	51 8	2 7	245	953	12 3	5,150	36	1 09	3	0
b	1 egg (48 gm)	77	6 1	5 5	3	26	101	1 3	540	04	12	Trace	0
302	*Scrambled												
a	1 pound	775	49 9	58 1	10 0	368	881	9 5	4,720	35	1 22	2	0
b	1 egg (62 gm)	106	6 8	7 9	1 4	50	120	1 3	640	05	.17	Trace	0
c	1 cup (220 gm)	376	24 2	28 2	4 8	178	427	4 6	2,290	17	59	1	0
	*Dried												
303	Whole, 1 cup (108 gm)	640	50 5	45 4	2 7	205	828	9 5	4,040	36	1.14	3	0
304	White, 1 cup (56 gm)	223	48 1	0	3 5	27	76	9	0	0	1 15	4	0
305	Yolk, 1 cup (96 gm)	666	30 0	58 8	1 2	271	1,078	13 2	5 320	48	64	.1	0
306	Endive raw, 1 pound E P	90	7 3	9	18 2	359	254	7 7	13,600	30	53	1 8	49
	Escarole, raw See Endive												
	Evaporated milk See Milk, cow												
	Farina												
	Unenriched												
307	Raw, 1 cup (169 gm)	625	18 4	1 4	130 8	47	189	1 7	(0)	09	10	1 4	(0)
308	*Cooked												
a	1 pound	198	5 9	5	41 3	14	59	5	0	03	03	5	(0)
b	1 cup (238 gm)	104	3 1	2	21 7	7	31	2	0	01	02	2	(0)
	Enriched												
308	Raw, 1 cup (169 gm)	625	18 4	1 4	130 8	47	189	[1] 2 2	(0)	[1] 62	[1] 45	[1] 2 2	(0)
310	*Cooked												
a	1 pound	198	5 9	5	41 3	14	59	9	0	18	14	7	(0)
b	1 cup (238 gm)	104	3 1	2	21 7	7	31	5	0	10	07	4	(0)

311	Fats cooking (vegetable fat)											
a	1 cup (200 gm)	1,768	0	200	0	0	0	0	0	0	0	0	0
b	1 tablespoon (12 5 gm)	110	0	12 5	0	0	0	0	0	0	0	0	0
	See also Lard Oils												
	Figs												
312	Raw, 3 small (1½ in diam 114 gm)	90	1 6	5	22 3	62	36	7	90	06	06	6	2
313	Canned syrup pack, solids and liquid												
a	1 cup (265 gm)	300	2 1	8	79 5	93	56	1 1	110	08	08	9	1
b	3 figs and 2 tablespoons syrup (114 gm)	129	9	3	34 2	40	24	5	60	03	04	4	1
314	Dried												
a	1 large (2 by 1 in 21 gm)	57	8	3	14 4	39	23	6	20	03	02	1	(0)
b	1 cup cut (168 gm)	473	6 7	2 0	114 9	312	196	5 0	110	20	20	2 9	(0)
315	Fig bars												
a	1 small (16 gm)	76	*	8	12 1	11	11	2	0	Trace	01	1	(0)
b	1 large (25 gm)	87	1 0	1 2	19 0	17	17	3	0	01	01	2	(0)
	Fish See individual kind as Bluefish Cod Halibut etc												
316	Flounder summer and winter raw 4 ounces E P	78	16 9	6	0	19	221	9		07	06	1 9	--
	Flour See Corn Rye Wheat flours etc												
	Frankfurters See Sausage												
317	Frog legs raw 4 ounces E P	82	18 6	3	0	20	167	1 2	0	16	29	1 3	--
318	Fruit cocktail, canned solids and liquid, 1 cup (256 gm)	179	1 0	5	47 6	23	31	1 0	410	03	03	9	5
	Garbanzos See Chick peas												
	Gelatin, dry												
319	Plain, 1 tablespoon (10 gm)	34	8 6	0	0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
320	Dessert powder 3 ounce package ½ cup	324	8 0	0	75 6	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value.

[1]Iron thiamine riboflavin and niacin are based on the *minimum levels of enrichment* specified in the standards of identity promulgated under the Food Drug and Cosmetic Act

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG.	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	*Gelatin dessert, ready to serve												
321	Plain												
a	1 pound	296	7.3	0	69.0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
b	1 cup (239 gm)	155	3.8	0	36.3	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
322	With fruit added												
a	1 pound	324	6.4	5	79.4	27	50	1.4	510	13	09	1.0	13
b	1 cup (241 gm)	172	3.4	2	42.2	14	27	.7	270	07	05	5	7
	Ginger ale See Beverages, carbonated												
323	*Gingerbread, 1 piece (2 by 2 by 2 in , 55 gm)	180	2.1	6.6	28.4	63	39	1.4	50	02	05	6	(0)
	Goat milk See Milk, goat												
324	Gooseberries, raw, 1 cup (150 gm)	59	1.2	3	14.6	33	42	8	440	--	--	--	49
	Grapefruit												
325	Raw, refuse, rind and seeds, 34%												
a	½ large (5 in diam , No 46's, 395 gm)	104	1.3	5	26.4	57	47	5	20	10	05	5	105
b	½ medium (4¼ in diam , No 64's, 285 gm)	75	9	4	19.0	41	34	4	20	07	04	4	76
c	½ small (3⅞ in diam , No 96's, 190 gm)	49	6	2	12.6	28	22	2	10	05	02	3	50
d	1 cup sections (194 gm)	77	1.0	4	19.6	43	35	4	20	07	04	4	78
326	Canned in syrup, solids and liquid, 1 cup (249 gm)	181	1.5	5	47.6	32	35	7	20	07	05	5	74
	Grapefruit juice												
327	Fresh, 1 cup (246 gm)	87	1.2	2	22.6	20	32	.7	20	09	05	5	99
	Canned.												
328	Unsweetened, 1 cup (246 gm)	92	1.2	2	24.1	20	32	7	20	07	04	4	85

3 [illegible]	Sweetened 1 cup ([illegible]1 gm)	131	1 [illegible]	3	[illegible]	[illegible]0	33	8	[illegible]0	08	04	[illegible]	97
330	Grapefruit juice concentrate frozen 1 *can* (*6 fluid ounces* 202 gm)	20[illegible]	3 8	8	[illegible]7 0	63	103	2 4	60	24	13	1 4	272
	Grapefruit orange juice blend												
	Canned												
331	Unsweetened 1 cup (240 gm)	99	1 5	2	25 6	22	37	[illegible]	110	11	04	5	92
332	Sweetened *1 cup* (*251 gm*)	132	1 3	3	34 9	23	38	8	110	12	04	5	94
333	Frozen concentrate, 1 can (6 fluid ounces 202 gm)	20[illegible]	4 4	8	[illegible]6 6	67	111	2 2	330	34	13	1 5	277
	Grapes raw												
334	American type (slip skin) as Concord Delaware Niagara and Scuppernong												
a	1 bunch ($3\frac{1}{2}$ by 3 in 100 gm)	55	1 1	1 1	11 [illegible]	13	16	5	60	05	03	2	3
b	1 cup with skins and seeds (153 gm)	84	1 [illegible]	1 [illegible]	1[illegible]	[illegible]0	25	7	90	07	05	3	5
335	European type (adherent skin) as Malaga Muscat Sultanina (Thompson Seedless) and Flame Tokay												
	1 cup (40 grapes $\frac{3}{4}$ in diam 160 gm)	10[illegible]	1 2	6	2[illegible] 9	26	33	9	120	0[illegible]	06	4	6
336	*Grape juice bottled commercial* 1 cup (254 gm)	1 0	1 0	0	46 2	2[illegible]	25	8		09	12	(6)	*Trace*
	Griddlecakes See Pancakes												
337	Guavas common raw refuse skins 1 guava (80 gm)	49	7	4	12 0	21	20	5	180	05	03	8	212
	Haddock												
339	Cooked fried												
a	1 pound	719	84 9	25 0	31 8	82	826	2 7	-	20	43	11 7	--
b	1 fillet (4 by 3 by ½ in 100 gm)	158	18 7	5 5	7 0	18	182	6	--	04	09	2 6	--

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Halibut												
341	Cooked, broiled												
a	1 pound	827	118 9	35 4	0	64	1,217	3 6	--	28	33	47 5	--
b	1 steak (4 by 3 by ½ in, 125 gm)	228	32 8	9 8	0	18	335	1 0	--	08	09	13 1	--
	Ham See Pork												
	Hamburger See Beef												
	Heart												
342	Beef, lean, raw, 3 ounces	92	14 4	3 1	6	8	173	3 9	30	50	.75	6 6	5
343	Calf, canned, strained (infant food), 1 ounce	23	3 8	.7	1	3	43	1 0	--	02	23	1 3	--
344	Chicken, raw, 3 ounces	134	17 4	6 0	1 4	20	121	1 4	30	10	.77	4 4	5
345	Pork, raw, 3 ounces	100	14 4	4 1	3	30	112	2 3	30	36	1 05	5 1	5
346	Herring, Atlantic, raw, 4 ounces E P	217	20 8	14 2	0	--	290	1 2	130	02	.17	3 9	--
347	Herring, lake, raw, 4 ounces E P	159	21 0	7 7	0	14	172	6	110	10	10	3 5	--
348	Herring, Pacific, raw, 4 ounces E P	106	18 8	2 9	0	--	--	--	110	03	25	(2 5)	--
349	Herring, smoked, kippered, 3 ounces E P	180	18 9	11 0	0	56	216	(1 2)	0	Trace	24	(2 5)	--
	Hominy, dry See Corn grits												
350	Honey, strained or extracted:												
a	1 cup (338 gm)	992	1 0	0	268 7	17	54	3 0	(0)	02	.13	.7	12
b	1 tablespoon (21 gm)	62	.1	0	16 7	1	3	2	(0)	Trace	01	Trace	1
351	Honeydew melon, raw												
a	1 wedge (2 by 7 in, 150 gm, from melon, 6½ by 7 in), without seeds and rind	49	8	0	12 8	(26)	(24)	(6)	60	07	04	3	34
352	*Ice cream, plain												
a	1 slice or individual brick (1/8 of quart brick, 81 gm)	167	[illegible]	[illegible]		0	80	1	420	03	15	[illegible]	

b	1 container 3½ fluid ounces (62 gm)	120	2.5	7.8	12.8	76	61	.1	320	.03	.12	.1	1
c	1 container 8 fluid ounces (142 gm)	291	5.7	17.8	29.3	175	141	.1	740	.06	.27	.1	1
353	Jams, marmalades, preserves, 1 *tablespoon (20 gm)*	55	.1	.1	14.2	2	2	.1	Trace	Trace	Trace	Trace	1
354	Jellies, 1 tablespoon (20 gm)	50	0	0	13.0	(2)	(2)	(.1)	(Trace)	(Trace)	(Trace)	(Trace)	1
356	Kale, cooked:												
a	1 pound	182	17.7	2.7	32.7	1,022	281	10.0	38,050	.32	1.01	7.7	232
b	1 cup (110 gm)	45	4.3	.7	7.9	249	69	2.4	9,220	.08	.25	1.9	76
	Kidneys, raw:												
358	Beef, 3 ounces	120	12.8	6.9	.8	8	188	6.7	980	.32	2.16	5.5	11
359	Pork, 3 ounces	97	13.9	3.9	.7	9	209	6.8	110	.50	1.47	8.4	11
360	Sheep, 3 ounces	89	14.1	2.8	.9	11	202	7.8	(980)	.44	2.06	6.5	11
	Kohlrabi												
361	Raw, 1 cup diced (138 gm)	41	2.9	.1	9.2	61	69	.8	Trace	.08	.07	.3	84
362	Cooked												
a	1 pound	136	9.5	.5	30.4	[illegible]	227	2.7	Trace	.18	.18	.9	168
b	1 *cup (155 gm)*	47	3.3	.2	10.4	71	78	.9	Trace	.06	.06	.3	57
	Lamb												
	Retail items, medium fat												
367	Rib chop, cooked												
a	1 pound with bone	1,254	72	105	0	31	600	9.0	(0)	.47	.77	17.0	0
b	1 pound without bone	1,900	109	159	0	50	908	13.6	(0)	.71	1.17	25.7	0
c	3 ounces without bone	356	20	30	0	9	170	2.6	(0)	.13	.22	4.8	0
369	Shoulder roast (wholesale 3 rib), cooked												
a	1 pound with bone	1,160	71	95	0	31	639	8.8	(0)	.41	.75	15.5	0
b	1 *pound without bone*	1,551	95	127	0	41	854	11.8	(0)	.55	1.01	20.7	0
c	3 ounces without bone	293	18	24	0	8	160	2.2	(0)	.10	.19	3.9	0
371	Leg roast (wholesale leg), cooked												
a	1 pound with bone	981	86	68	0	36	923	11.1	(0)	.49	.89	18.4	0
b	1 pound without bone	1,241	109	86	0	45	1,167	14.1	(0)	.62	1.13	23.3	0
c	3 ounces without bone	230	20	16	0	9	219	2.6	(0)	.12	.21	4.4	0
372	Canned, strained (infant food), 1 ounce	30	4.4	1.2	0	5	48	.7	(0)	.01	.07	1.1	0

Note: Asterisk indicates that values are calculated from a *recipe*; parentheses indicate imputed value.

[1]Based on 5 pounds of ice cream to the gallon, factory packed.

TABLE 138—CONT'D

	FOOD, DESCRIPTION AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Lamb and vegetable soup, canned, strained (infant food) *See* Soups, canned vegetable and lamb												
373	Lard												
a	1 cup (220 *gm*)	1,984	0	220	0	0	0	0	0	0	0	0	0
b	*1 tablespoon (14 gm)*	126	*0*	*14*	*0*	*0*	*0*	*0*	0	*0*	*0*	*0*	0
374	Lemons, refuse, rind and seeds, 38%, 1 medium lemon (2¼ by 2 in, 100 gm)	20	6	4	5 4	25	14	4	0	03	Trace	1	31
	Lemon juice												
375	Fresh												
a	1 cup (246 gm)	59	1 0	5	18 9	34	27	2	0	11	01	3	122
b	1 tablespoon (15 gm)	4	1	0	1 2	2	2	0	0	01	Trace	Trace	7
	Canned												
376	Unsweetened												
a	1 cup (246 gm)	59	1 0	5	18 9	34	27	2	0	11	.01	3	104
b	1 tablespoon (15 gm)	4	1	0	1 2	2	2	0	0	01	Trace	Trace	6
380	Lettuce, headed, raw												
a	1 head, *loose leaf* (4 in diam 220 gm)	32	2 6	4	6 4	48	55	1 1	1,200	10	.18	4	17
b	1 head, compact (4¾ in diam, *1 pound*)	68	5 4	9	13 2	100	114	2 3	2,470	20	38	9	35
c	2 large or 4 small leaves (50 gm)	7	6	1	1 4	11	12	2	270	02	04	.1	4
382	Limes, refuse, *rind* and seeds, 24%, 1 medium lime (2 in diam, 68 gm)	19	4	1	6 4	(21)	(11)	(3)	0	(02)	(Trace)	(1)	14
383	Lime juice, fresh 1 cup (246 gm)	58	1 0	0	20 4	(34)	(27)	(2)	0	(11)	(01)	(3)	65

	Liver												
385	Beef, cooked fried, 2 ounces	118	13.4	4.4	5.5	5	276	4.4	30 330	15	2.25	8.4	19
386	Calf raw, 3 ounces	120	16.2	4.2	3.4	5	292	10	19 130	18	2.65	13.7	30
387	Chicken raw 3 ounces	120	18.8	7.4	2.2	14	204	6.3	27 370	17	2.10	10.0	17
388	Pork, raw 3 ounces	114	16.7	4.1	1.4	8	308	15.3	12 070	34	2.53	14.2	19
389	Sheep or lamb, raw, 3 ounces	116	17.8	3.3	2.5	7	309	10.7	42 930	34	2.79	14.3	28
390	Liver, canned, strained (infant food), 1 ounce	30	4.5	1.1	3	7	79	2.0	5 440	01	61	1.8	--
	Liver sausage See Sausage												
	Liverwurst See Sausage, liver												
392	Lobster, canned 3 ounces	78	15.6	1.1	3	55	163	7	--	(03)	06	(1.9)	--
393	Loganberries raw 1 cup (144 gm)	90	1.4	9	21.6	70	27	1.7	(290)	(04)	(10)	(4)	34
	Macaroni												
	Unenriched												
394	Dry												
a	1 cup elbow type (123 gm)	463	15.7	1.7	94.1	27	203	1.8	(0)	11	07	2.5	(0)
b	1 cup (1 in pieces 110 gm)	415	14.1	1.5	84.2	24	182	1.6	(0)	10	07	2.2	(0)
c	1 cup 2 in pieces 86 gm	324	11.0	1.2	65.8	19	142	1.3	(0)	08	05	1.7	(0)
395	*Cooked												
a	1 pound	678	23.2	2.7	137.1	41	295	2.7	(0)	08	08	2.2	(0)
b	1 cup (1 in pieces or elbow type 140 gm	209	7.1	8	42.3	13	91	8	(0)	03	02	7	(0)
	Enriched												
396	Dry												
a	1 cup elbow type (123 gm)	463	15.7	1.7	94.1	27	203	[1]3.6	(0)	[1]1.08	[1]46	[1]7.3	(0)
b	1 cup (1 in pieces 110 gm)	415	14.1	1.5	84.2	24	182	[1]3.2	(0)	[1]97	[1]41	[1]6.5	(0)
c	1 cup (2 in pieces 86 gm)	324	11.0	1.2	65.8	19	142	[1]2.5	(0)	[1]76	[1]32	[1]5.1	(0)
397	*Cooked												
a	1 pound	678	23.2	2.7	137.1	41	295	5.0	(0)	79	47	6.4	(0)
b	1 cup (1 in sticks or elbow type 140 gm)	209	7.1	8	42.3	13	91	1.5	(0)	24	15	2.0	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1]Iron thiamine riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity promulgated under the Food Drug and Cosmetic Act

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
398	*Macaroni and cheese, baked												
a	1 pound	957	36 8	49 9	89 4	867	767	[1] 2 3	2,050	[1] .15	[1] 71	[1] 1 8	Trace
b	1 cup (220 gm)	464	17 8	24 2	43 3	420	372	[2] 1 1	990	[2] 07	[2] 35	[2] 9	Trace
	Mackerel, canned, solids and liquids												
400	Atlantic, 3 ounces	155	16 4	9 4	0	157	233	1 8	370	05	.18	4 9	--
401	Pacific, 3 ounces	153	17 9	8 5	0	221	245	1 9	20	02	28	7 4	--
402	Mangos, raw, 1 medium (200 gm), refuse, seeds and skin, 34%	87	9	3	22 7	12	17	3	8,380	08	07	1 2	55
403	Margarine												
a	1 cup (224 gm)	1 613	1 3	181 4	9	45	36	0	[4] 7,400	--	--	--	(0)
b	1 tablespoon (14 gm)	101	1	11 3	1	3	2	0	[4] 460	--	--	--	(0)
c	1 pat (64 per pound, 7 gm)	50	0	5 7	0	1	1	0	[4] 230	--	--	--	(0)
	Marmalades See Jams, marmalades, preserves												
	Mayonnaise See Salad dressings												
	Meat See Beef, Lamb, Pork, Veal												
	Melons See Cantaloups, Honeydew, Watermelons												
	Milk, cow												
	Fluid (pasteurized and raw)												
404	Whole:												
a	1 quart (976 gm)	666	34 2	38 1	47 8	1,152	[1] 908	7	(1,550)	35	1 68	1 1	13
b	1 cup (244 gm)	166	8 5	9 5	12 0	288	227	2	(390)	.09	42	3	3
405	Nonfat (skim):												
a	1 quart (984 gm)	350	34 4	1 0	50 2	1,210	954	7	(40)	35	1 75	1 1	13
b	1 cup (246 gm)	87	8 6	2	12 5	303	239	2	(10)	09	44	3	3
406	Canned. Evaporated (unsweetened), 1 cup (252 gm)	346	17 6	19 9	24 9	612	[illegible]	4	1,010	12	91	5	3

407	Condensed (sweetened), 1 cup (306 gm)	981	24.8	25.7	167.7	835	698	6	(1,300)	16	1.19	6	3
	Dried:												
408	Whole:												
a	1 cup (128 gm)	630	33.0	34.2	48.6	1,215	932	7	1,700	29	1.87	8	8
b	1 tablespoon (8 gm)	39	2.1	2.1	3.0	76	58	0	110	02	12	1	1
409	Nonfat solids (skim)												
a	1 cup (120 gm)	434	42.7	1.2	62.4	1,560	1,236	7	(50)	42	2.35	1.4	9
b	1 tablespoon (7.5 gm)	28	2.7	1	3.9	98	77	0	(Trace	03	15	1	1
	Malted[5]												
410	Dry powder, 1 ounce	115	4.1	2.4	20.0	81	107	6	290	09	15	--	(0)
411	*Beverage, 1 cup (270 gm)	281	12.4	11.9	31.9	344	332	8	680	18	56	--	7
412	*Chocolate flavored												
a	1 quart (1 kg)	740	32.0	22.0	106.0	1,090	910	7	910	32	1.59	1.0	10
b	1 cup (230 gm)	185	8.0	5.5	26.5	272	228	2	230	08	40	2	2
413	Half and half (milk and cream)												
a	1 quart (968 gm)	1,322	31.0	116.2	43.6	1,045	823	6	4,760	32	1.52	1.0	12
b	1 cup (242 gm)	330	7.7	29.0	10.9	261	206	1	1,190	08	38	2	3
	Buttermilk. See Buttermilk												
414	Milk, goat, fluid												
a	1 quart (976 gm)	654	32.2	39.0	44.9	1,251	1,035	1.0	(1,550)	39	1.01	2.8	10
b	1 cup (244 gm)	164	8.1	9.8	11.2	315	259	2	(390)	10	26	.7	2
	Molasses, cane												
415	First extraction or light												
a	1 cup (328 gm)	825	--		[6]213.2	541	148	14.1	--	23	21	8	--
b	1 tablespoon (20 gm)	50	-		[6]13.0	33	9	9	--	01	01	Trace	--
416	Second extraction or medium												
a	1 cup (328 gm)	762			[6]196.8	951	226	19.7	--	--	33	3.9	--
b	1 tablespoon (20 gm)	46	--	--	[6]12.0	58	14	1.2	--	--	02	2	--

Note. Asterisk indicates that values are calculated from a recipe; parentheses indicate imputed value.

[1]If enriched macaroni is used in the recipe, the values for iron, *thiamine, riboflavin,* and niacin would be 3.2, 0.45, 0.91, and 4.1 mg., respectively.

[2]If enriched macaroni *is* used *in the recipe,* the values for iron, thiamine, riboflavin, and niacin would be 1.5, 0.22, 0.41, and 2.0 mg., respectively.

[3]*The vitamin values are based on the drained solids.*

[4]Based on the average vitamin A content of fortified margarine. Most of the margarines manufactured *for use in the United* States have 15,000 I.U. of vitamin A added per pound. The minimum Federal specifications for fortified margarine require the addition of 9,000 I.U. of vitamin A per pound.

[5]Based on unfortified products.

[6]Total sugars.

TABLE 138—CONT'D

	FOOD DESCRIPTION AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Molasses—Cont d												
417	Third extraction or blackstrap												
a	1 cup (328 gm)	698			[1]180 4	1 899	279	37 1	--	39	59	5 2	--
b	1 tablespoon (20 gm)	43		--	[1] 11 0	116	17	2 3		02	04	3	--
418	Barbados												
a	1 cup (328 gm)	889			[1]229 6		164	--	-	19	66		--
b	1 tablespoon (20 gm)	54			[1] 14 0		10		-	01	04	-	--
	*Muffins made with												
419	Unenriched flour 1 muffin (2¾ in diam 48 gm)	134	3 8	4 0	20 2	99	92	3	50	02	06	2	(0)
420	Enriched flour 1 muffin (2¾ in diam 48 gm)	134	3 9	4 0	20 2	99	92	8	50	09	10	7	(0)
421	Mung bean sprouts raw 1 cup (90 gm)	21	2 6	2	3 7	26	53	7	10	06	08	5	14
423	Mushrooms canned solids and liquid 1 cup (244 gm)	28	3 4	5	9 0	(17)	(220)	(2 0)	0	04	60	4 8	--
	Muskmelons See Cantaloups and Honeydew melon												
425	Mustard greens, cooked												
a	1 pound	102	10 4	1 4	18 2	999	173	13 2	32 600	27	82	3 2	204
b	1 cup (140 gm)	31	3 2	4	5 6	308	53	4 1	10 050	08	25	1 0	63
	Noodles (containing egg)												
	Unenriched												
426	Dry, 1 cup (1½ in strips 73 gm)	278	9 2	2 5	53 4	16	145	1 5	140	15	08	1 7	(0)
427	*Cooked												
a	1 pound	302	10 0	2 7	58 1	18	159	1 8	160	15	09	1 8	(0)
b	1 cup (160 gm)	107	3 5	1 0	20 5	6	56	6	60	05	03	6	(0)
	Enriched												
428	Dry 1 cup (1½ in strips 73 gm)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	145	[2]2 1	140	[2] 64	[2] 27	[2] 4 3	(0)

429	*Cooked											
a	1 pound	302	10.0	2.7	58.1	19	179	2.3	160	.63	.30	4.8	(0)
b	1 cup (160 gm)	107	3.5	1.0	20.5	6	56	.8	60	.22	.10	1.7	(0)
430	Oat cereal ready to eat (added vitamins and minerals) 1 cup (25 gm)	100	3.6	1.8	17.6	40	88	1.0	(0)	.20	.05	.5	(0)
	Oatmeal or rolled oats											
431	Dry 1 cup (80 gm)	312	11.4	5.9	54.6	42	324	3.6	(0)	.48	.11	.8	(0)
432	*Cooked											
a	1 pound	285	10.4	5.4	49.9	41	304	3.2	(0)	.43	.10	.8	(0)
b	1 cup (236 gm)	148	5.4	2.8	26.0	21	158	1.7	(0)	.22	.05	.4	(0)
433	Precooked (infant food) dry 1 ounce	106	4.3	1.4	19.5	[illegible]	226	[illegible]	(0)	.71	.10	[illegible]	(0)
434	Oils salad or cooking											
a	1 cup (220 gm)	1,945	0	220	0	0	0	0	0	0	0	0	0
b	1 tablespoon (14 gm)	124	0	14	0	0	0	0	0	0	0	0	0
436	Okra cooked											
a	1 pound	148	8.2	.9	33.6	[illegible]	281	3.2	[illegible]	[illegible]	[illegible]	[illegible]	91
b	8 pods (3 in long 5/8 in diam 85 gm)	28	1.5	.2	6.3	[illegible]	[illegible]	.6	620	.05	.05	.7	17
	Oleomargarine See Margarine											
	Olives pickled mammoth size (13/16 by 1 1/8 in refuse 16%)											
437	Green 10 olives (65 gm)	72	.8	7.4	2.2	48	9	0	100	Trace		—	—
	Ripe											
438	Mission 10 olives (65 gm)	106	1.0	11.6	1.4	48	9	.9	40	Trace	Trace		—
439	Other varieties (as ascalano manzanilla and sevilano) 10 olives (65 gm)	70	.7	7.4	1.7	48	9	1	70	Trace	Trace		—
	Omelet See Eggs omelet											

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value
[1]Total sugars
[2]Iron thiamine riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity promulgated under the Food Drug and Cosmetic Act
[3]Based on products ranging from 0.4 to 1.3 mg per ounce of cereal The niacin value of some products is as high as 6.5 mg per ounce

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG.	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG.
440	Onions, mature												
	Raw												
a	1 onion (2½ in diam), E P (110 gm)	49	1.5	.2	11.3	35	48	.6	60	.04	.04	.2	10
b	1 tablespoon chopped (10 gm)	4	.1	.0	1.0	3	4	.0	Trace	Trace	Trace	Trace	1
441	Cooked whole												
a	1 pound	172	4.5	.9	39.5	145	200	2.3	230	.09	.14	.9	27
b	1 cup (210 gm)	79	2.1	.4	18.3	67	92	1.0	110	.04	.06	.4	13
443	Onions, young green, 6 small onions without tops (50 gm)	23	.5	.1	5.3	68	12	.4	(30)	(.02)	(.02)	(.1)	12
444	Oranges, refuse, rind and seeds, 28%												
a	1 large (3⅜ in diam, No 126's, 325 gm)	106	2.1	.5	26.2	77	54	.9	(440)	.18	.06	.6	116
b	1 medium (3 in diam, No 200's, 215 gm)	70	1.4	.3	17.4	51	36	.6	(290)	.12	.04	.4	77
c	1 small (2½ in diam, No 288's, 150 gm)	49	1.0	.2	12.1	36	25	.4	(200)	.08	.03	.3	53
d	1 cup sections (193 gm)	87	1.7	.4	21.6	64	44	.8	(360)	.13	.05	.5	95
	Orange juice												
445	Fresh, 1 cup (246 gm)	108	2.0	.5	27.1	47	39	.5	(460)	.19	.06	.6	122
	Canned												
446	Unsweetened, 1 cup (246 gm)	109	2.0	.5	27.3	25	44	.7	(240)	.17	.04	.6	103
447	Sweetened, 1 cup (251 gm)	135	1.5	.5	34.9	25	45	.8	(250)	.18	.05	.6	105
	Orange juice concentrate												
448	Canned, 1 ounce	65	1.2	.2	16.4	17	25	.5	(140)	.10	.02	.3	63
449	Frozen, 1 can (6 fluid ounces, 202 gm)	300	5.5	1.4	74.9	69	121	2.0	(670)	.48	.11	1.5	285
450	Oysters, meat only, raw, 1 cup (13 19 medium size oysters, selects 240 gm)	200	23.5	5.0	13.4	226	343	13.4	770	.35	.48	[illegible]	[illegible]

	*Oyster stew												
451	1 part oysters to 3 parts milk by volume												
a	1 pound	413	24 1	24 5	24 1	531	499	6 8	1 250	20	84	1 8	--
b	1 cup (with 3 4 oysters, 230 gm)	209	12 2	12 4	12 2	29	253	3 4	650	14	42	9	--
452	1 part oysters to 1 part milk by volume												
a	1 pound	461	31 3	25 0	26 8	495	551	13 2	1 700	40	86	3 0	--
b	1 cup (with 6 8 oysters, 240 gm)	244	16 6	13 2	14 2	262	293	7 0	920	21	46	1 6	--
	*Pancakes (griddlecakes), baked												
	Wheat (home recipe)												
453	With unenriched flour												
a	1 pound	991	29 9	41 8	120 8	717	699	2 7	590	26	59	1 5	2
b	1 cake (4 in diam 27 gm	59	1 8	2 5	7 2	43	42	2	30	02	03	1	Trace
454	With enriched flour												
a	1 pound	991	30 9	41 8	120 8	717	699	5 9	500	84	97	7 7	2
b	1 cake (4 in diam 27 gm	59	1 8	2 5	7 2	43	42	4	30	05	06	3	Trace
455	Buckwheat with buckwheat pancake mix												
a	1 pound	798	27 7	38 1	94 0	1 133	1 613	5 4	290	72	72	3 9	3
b	1 cake (4 in diam 27 gm)	47	1 6	2 3	5 6	67	98	3	70	04	04	2	Trace
	Pancake mix dry self rising												
	Wheat (mixed with other flours)												
456	Unenriched 1 cup (135 gm)	471	12 8	1 1	98 7	628	919	2 7	0	20	10	1 9	(0)
457	Enriched 1 cup (135 gm)	471	12 8	1 9	98 7	628	919	4 5	0	33	12	3 9	(0)
458	Buckwheat, 1 cup (135 gm)	432	14 2	2 6	94 0	670	1 116	4 2	0	49	15	3 0	(0)
459	Papayas, raw, 1 cup (½ in cubes 182 gm)	71	1 1	2	18 2	36	29	5	3,190	06	07	5	102
460	Parsley, common raw, 1 tablespoon chopped (3 5 gm)	1	1	0	3	[1] 7	3	2	290	Trace	01	1	7
462	Parsnips cooked												
a	1 pound	274	4 5	2 3	63 1	259	283	3 2	0	27	45	9	54
b	1 cup (155 gm)	94	1 6	8	21 5	88	124	1 1	0	09	16	3	19

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value
[1]Calcium may not be available because of presence of oxalic acid

Table 138—Cont'd

	Food, description, and approximate measure	Food energy cal.	Protein gm	Fat gm	Total carbohydrate gm	Calcium mg	Phosphorus mg	Iron mg	Vitamin A value I U	Thiamine mg	Riboflavin mg	Niacin mg	Ascorbic acid mg
	Pastry shell, plain See Pie crust												
	Peaches												
463	Raw												
a	1 medium, refuse, pits and skins, 12% (2½ by 2 in diam, 114 gm)	46	5	1	12 0	8	22	6	880	02	05	9	8
b	1 cup, sliced (168 gm)	77	8	2	20 2	13	37	1 0	1,480	04	08	1 5	13
	Canned, solids and liquid												
464	Water pack, 1 cup (244 gm)	66	1 2	2	16 6	12	34	1 0	1,110	02	05	1 7	10
465	Syrup pack												
a	1 cup (256 gm)	174	1 0	3	46 6	13	36	1 0	1,160	02	05	1 8	11
b	2 medium halves and 2 tablespoons syrup (117 gm)	79	5	1	21 3	6	16	5	530	01	02	8	5
466	Strained (infant food), 1 ounce	17	2	1	4 3	2	5	3	180	01	01	2	1
467	Frozen, 4 ounces	89	5	1	22 9	7	17	5	590	01	03	6	5
468	Dried, sulfured												
469	Uncooked, 1 cup (160 gm)	424	4 8	1 0	111 0	70	202	11 0	5,200	02	31	8 6	30
	*Cooked, no sugar added, 1 cup (10 12 halves plus 6 tablespoons liquid, 270 gm)	224	2 4	5	58 9	38	105	5 9	2,750	01	16	4 3	11
470	*Cooked, sugar added, 1 cup 10 12 halves plus 6 tablespoons liquid, 305 gm)	366	2 4	6	95 5	37	107	5 8	2,750	01	15	4 3	12
471	Peanuts, Virginia type, roasted												
a	Shelled												
	1 cup medium halves (144 gm)	805	38 7	63 6	34 0	107	566	2 7	0	42	19	23 3	(0)
b	1 tablespoon, chopped (9 gm)	50	2 4	4 0	2 1	7	35	2	0	03	01	1 5	(0)
472	Peanut butter												
a	1 cup (258 gm)	1,486	67 3	123 3	54 2	191	1,014	4 9	0	31	34	41 8	(0)
b	1 tablespoon (16 gm)	92	4 2	7 6	3 4	12	63	3	0	02	02	2 6	(0)

473 Pears Raw												
a 1 pear refuse skin and core 17% (3 by 2½ in diam 182 gm)	95	1.1	.6	23.9	20	21	.5	30	.03	.06	.2	6
b 1 cup, quartered (192 gm)	100	1.3	.8	30.3	25	31	.6	40	.04	.08	.3	8
Canned, solids and liquid												
474 Water pack, 1 cup (242 gm)	75	.7	.2	19.8	19	24	.5	10	.02	.04	.3	4
475 Syrup pack												
a 1 cup (256 gm)	174	.5	.3	47.1	20	26	.5	10	.02	.04	.4	5
b 2 medium size halves plus 2 tablespoons syrup (117 gm)	79	.2	.1	21.5	9	12	.2	Trace	.01	.02	.2	2
476 Strained (infant food) 1 *ounce*	15	.2	.1	3.7	3	4	(.1)	10	Trace	.01	.1	Trace
Peas green immature												
478 Cooked												
a 1 pound	316	22.2	1.8	54.9	100	534	8.6	3,270	1.44	.64	10.4	68
b 1 cup (160 gm)	111	7.8	.6	19.4	35	195	3.0	1,170	.40	.22	3.7	24
Canned												
479 Solids and liquid 1 cup (249 gm)	168	8.5	1.0	32.1	62	167	4.5	1,370	.28	.15	2.0	21
480 Drained solids												
a 1 pound	411	20.4	2.7	78.1	115	350	9.5	3,030	.54	.30	4.5	42
b 1 cup (160 gm)	145	7.2	1.0	27.5	51	123	3.4	1,070	.19	.10	1.6	15
481 Strained (infant food) 1 *ounce*	14	1.2	.1	2.2	5	18	.4	180	.03	.02	.3	2
Peas, mature dry seeds												
483 Entire seeds 1 cup (200 gm)	679	47.6	2.8	120.4	114	776	9.4	740	1.53	.56	6.3	4
484 Split without seed coat 1 cup (200 gm)	689	49.0	2.0	123.4	66	536	10.2	740	1.53	.56	6.3	4
Pea soup, dehydrated See Soups dehydrated												
485 Pecans												
a 1 cup, halves (108 gm)	752	10.2	78.8	14.0	80	350	2.6	50	.77	.12	1.0	2
b 1 tablespoon chopped (7.5 gm)	52	.7	5.5	1.0	6	24	.2	Trace	.05	.01	.1	Trace

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
486	Peppers, green Raw, 1 medium, refuse, stem end, seeds and core, 16% (76 gm)	16	8	1	3 6	7	16	3	400	02	04	2	77
487	Cooked, parboiled then baked												
a	1 pound	119	5 9	9	27 2	50	114	1 8	3,360	18	32	1 8	449
b	1 pepper, medium (65 gm)	17	8	1	3 9	7	16	3	480	03	05	3	64
488	Persimmons, Japanese or Kaki, raw, 1 persimmon (2¼ in diam, 125 gm)												
a	Seedless kind, refuse, skin, 3%	95	1 0	5	24 2	7	31	4	3,270	06	05	Trace	13
b	Kind with seeds, refuse, skin and seeds, 24%	74	8	4	19 0	6	25	3	2,570	05	04	Trace	10
	Pickles												
489	Dill, cucumber, 1 large (1¾ in diam, 4 in long, 135 gm)	15	9	3	2 8	34	27	1 6	420	Trace	09	1	8
490	Fresh, cucumber (as bread and butter pickles)												
a	1 cup (22-24 slices, 170 gm)	118	1 5	3	28 9	54	46	3 1	310	04	07	.1	15
b	6 slices (¼ in by 1½ in diam, 42 gm)	29	4	1	7 1	13	11	8	80	01	02	Trace	4
491	Sour, cucumber or mixed, 1 large (1¾ in diam, 4 in long, 135 gm)	15	7	3	3 0	34	27	1 6	420	Trace	09	Trace	8
492	Sweet, cucumber or mixed												
a	1 pickle (2¾ in long, ¾ in diam, or 2 pickles 2 in long, ⅝ in diam, 20 gm)	22	2	1	5 3	3	4	3	20	(0)	Trace	Trace	1
b	1 cup, mixed, chopped (210 gm)	225	1 7	8	55 4	34	38	2 7	240	(0)	04	Trace	15
c	1 tablespoon, mixed, chopped (13 gm)	14	1	1	[illegible]	2	2	2	10	(0)	Trace	Trace	1

Pies												
493 *Apple												
a 1 pie (9 in diam 945 gm)	[illegible]	10.8	89.8	373.3	[illegible]	[illegible]	3.8	1,310	[illegible]	.16	2.3	[illegible]
b 4 inch sector (or 1/4 of 9 in diam 135 gm)	[illegible]	2.8	12.8	53.3	9	32	.5	[illegible]	.04	.02	.3	1
c 1 inch sector (of 9 in diam, 34 gm)	83	[illegible]	3.2	13.3	2	8	.1	[illegible]	.01	.01	.1	Trace
494 *Blueberry												
a 1 pie (9 in diam 945 gm)	2,012	10.8	65.2	374.4	94	[illegible]	4.7	1,110	.15	.28	2.3	[illegible]
b 4 inch sector (or 1/4 of 9 in diam, 135 gm)	[illegible]	2.8	9.3	50.6	11	30	[illegible]	[illegible]	.02	.04	.3	5
c 1 inch sector (of 9 in diam 34 gm)	73	[illegible]	[illegible]	12.7	3	7	.2	40	.01	.01	.1	1
495 *Cherry												
a 1 pie (9 in diam 945 gm)	[illegible]	[illegible]	[illegible]	381.8	94	275	3.8	3,610	[illegible]	.16	2.4	13
b 4 inch sector (or 1/4 of 9 in diam 135 gm)	340	3.2	[illegible]	[illegible]	11	36	.5	520	.04	.02	.3	2
c 1 inch sector (of 9 in diam 34 gm)	[illegible]	.8	3.3	[illegible]	3	9	.1	[illegible]	.01	.01	.1	Trace
496 Coconut custard												
a 1 pie (9 in diam 910 gm)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2,000	.46	1.49	2.7	(0)
b 4 inch sector (or 1/4 of 9 in diam 130 gm)	[illegible]	6.8	11.3	34.2	[illegible]	[illegible]	1.6	290	.07	.21	.4	(0)
c 1 inch sector (of 9 in diam 32 gm)	66	1.7	2.8	8.6	41	38	.4	70	.02	.05	.1	(0)
497 Custard												
a 1 pie (9 in diam 910 gm)	[illegible]	47.3	[illegible]	[illegible]	1,138	1,056	10.9	2,000	.46	[illegible]	2.7	(0)
b 4 inch sector (or 1/4 of 9 in diam 130 gm)	[illegible]	6.8	11.3	34.2	162	151	1.6	290	.07	.21	.4	(0)
c 1 inch sector (of 9 in diam 32 gm)	66	1.7	2.8	8.6	41	38	.4	70	.02	.05	.1	(0)
498 Lemon meringue												
a 1 pie (9 in diam 840 gm)	2,114	30.2	84.8	314.2	168	428	4.2	1,400	.27	.70	1.6	8
b 4 inch sector (or 1/7 of 9 in diam 120 gm)	302	4.3	12.1	44.9	24	61	.6	210	.04	.10	.2	1
c 1 inch sector (of 9 in diam 30 gm)	76	1.1	3.0	11.2	6	15	.2	50	.01	.02	.1	Trace

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL.	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Pies—Cont'd												
499	Mince												
a	1 pie (9 in diam, 945 gm)	2,386	23 6	65 2	430 9	151	378	20 8	70	64	33	3 3	6
b	4 inch sector (or ⅙ of 9 in diam, 135 gm)	341	3 4	9 3	61 6	22	54	3 0	10	09	05	5	1
c	1 inch sector (of 9 in diam, 34 gm)	85	8	2 3	15 4	5	14	7	Trace	02	01	1	Trace
500	*Pumpkin												
a	1 pie (9 in diam, 910 gm)	1,842	38 2	87 4	234 8	491	737	7 3	17,350	30	1 06	2 9	2
b	4 inch sector (or ⅙ of 9 in diam, 130 gm)	263	5 5	12 5	33 5	70	105	1 0	2,480	04	15	4	(0)
c	1 inch sector (of 9 in diam, 32 gm)	66	1 4	3 1	8 4	18	26	3	620	01	04	1	(0)
	Pie crust, plain												
501	*Baked with Unenriched flour												
a	1 lower crust, 9 inch shell (135 gm)	657	10 1	36 3	71 7	15	88	7	0	05	03	.7	(0)
b	1 double crust, for 9 inch pie (270 gm)	1,314	20 2	72 6	143 4	30	176	1 4	0	09	06	1 4	(0)
502	Enriched flour												
a	1 lower crust, 9 inch shell (135 gm)	657	10 1	36 3	71 7	15	88	2 7	0	29	23	3 0	(0)
b	1 double crust, for 9 inch pie (270 gm)	1,314	20 2	72 6	143 4	30	176	5 4	0	58	47	5 9	(0)
503	Unbaked (fresh or frozen), 1 pound	1,946	30 0	107 6	212 0	41	259	1 8	0	20	09	2 2	(0)
504	Pimientos, canned, 1 medium (38 gm)	10	3	2	2 2	3	6	6	870	01	02	1	36
505	Pineapple Raw												
a	1 cup, diced (140 gm)	7[illegible]	6	3	19 2	22	15	4	[illegible]0	12	04	3	33

l	1 slice (¼ in thick 3½ in diam 84 gm)	44	3	2	11.5	13	9	3	110	07	02	2	20
506	Canned syrup pack solids and liquid												
a	*1 cup crushed (260 gm)*	204	1.0	3	[illegible]	[illegible]	18	1.6	210	20	01	4	23
b	2 small or 1 large slice plus 2 tablespoons juice (122 gm)	95	5	1	25.7	35	9	7	100	09	02	2	11
507	*Frozen 4 ounces*	97	[illegible]	2	25.2	16	11	3	110	07	02	2	22
508	Pineapple juice canned 1 cup (249 gm)	121	[illegible]	2	32.4	37	20	1.2	200	13	04	4	22
510	Plums (all excluding prunes) raw												
a	1 plum (2 in diam 60 gm) refuse pits 5%	29	4	1	[illegible]	10	11	3	200	04	02	3	3
b	1 cup halves (2 in diam 185 gm)	94	1.3	4	23.9	31	37	9	[illegible]	12	08	[illegible]	9
	Plums (Italian prunes) canned												
511	Syrup pack												
a	*1 cup fruit and juice 256 gm) refuse pits 4%*	18[illegible]	1.0	2	[illegible]	20	30	2.7	510	07	06	[illegible]	3
b	3 prunes (without pits) plus 2 tablespoons juice (122 gm)	92	5	1	24.9	10	[illegible]	1.3	280	03	03	5	1
	Popcorn												
513	Popped 1 cup (14 gm)	54	1.8	*	10.7	(2)	(39)	(.4)	(0)	(.05)	(.02)	(.3)	(0)
	Pork fresh												
	Retail items cooked												
518	Ham												
a	1 pound with bone	1,43[illegible]	86	118	0	39	854	11.1	(0)	1.90	86	16.9	0
b	1 pound without bone	1,818	109	150	0	50	1,081	14.1	(0)	2.40	1.09	21.3	0
c	3 ounces without bone	338	20	28	0	9	202	2.6	(0)	45	20	4.0	0
520	Loin or chops												
a	1 pound with bone	1,149	79	90	0	38	911	10.4	(0)	2.86	83	17.4	0
b	1 pound without bone	1,508	104	118	0	50	1,067	13.6	(0)	3.77	1.09	22.8	0
c	1 chop (115 gm)	293	20	23	0	10	204	2.6	(0)	72	21	4.4	0
d	3 ounces without bone	284	20	22	0	9	200	2.6	(0)	71	20	4.3	0

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value
[1]The proximate constituents calcium phosphorus and vitamin A are calculated from a recipe

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Pork—Cont'd												
523	Pork, cured												
	Ham, smoked, cooked												
a	1 pound with bone	1,496	87	124	(1 5)	38	626	10 9	(0)	2 04	80	15 7	0
b	1 pound without bone	1 804	104	150	(1 8)	45	754	13 2	(0)	2 46	96	18 9	0
c	3 ounces without bone	339	20	28	(3)	9	141	2 5	(0)	46	18	3 5	0
	Luncheon meat												
524	Boiled ham, 2 ounces	172	12 9	12 9	0	5	52	1 5	(0)	57	.15	2 9	0
525	Canned, spiced, 2 ounces	164	8 4	13 8	9	5	91	1 2	(0)	18	.12	1 6	0
	Sausage, pork links or bulk, raw See Sausage, pork												
527	Pork, canned, strained (infant food), 1 ounce	36	4 8	1 7	0	4	51	5	(0)	10	08	1 3	0
	Potatoes												
	Cooked												
529	Baked												
a	1 pound	446	10 9	5	102 2	59	300	3 6	110	50	21	6 4	77
b	1 medium potato (2½ in diam, peeled, 99 gm, or unpeeled, 128 gm, refuse, 23%)	97	2 4	1	22 3	13	65	8	20	11	05	1 4	17
530	Boiled, unpeeled before cooking												
a	1 pound, refuse, cooked skins, 5%	359	8 6	4	82 3	47	241	3 0	80	43	17	5 0	66
b	1 medium potato (2½ in diam, peeled, 142 gm, or unpeeled, 150 gm, refuse, 5%)	118	2 8	1	27 1	16	80	1 0	30	14	06	1 6	22
531	Boiled, peeled before cooking												
a	1 pound	378	9 1	3	86 7	50	254	3 2	80	43	.15	4 6	62
b	1 medium potato (2½ in diam) or 1 cup diced (126 gm)	105	2 5	1	14	71	9	20	12	04	1 3	17	

[illegible]	[illegible]												
a	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]
b	[illegible] (40 gm)	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	11
3	*[illegible]												
a	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
b	1 cup [illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]			[illegible]	[illegible]	[illegible]	[illegible]
534	*[illegible]												
a	[illegible]	[illegible]			[illegible]		[illegible]	[illegible]	[illegible]			[illegible]	[illegible]
b	[illegible]	[illegible]	[illegible]				[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	*[illegible]												
a	[illegible]						[illegible]		[illegible]			[illegible]	[illegible]
b	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
536	*[illegible]												
a	[illegible]						[illegible]		[illegible]			[illegible]	[illegible]
b	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]		1	1	[illegible]	1
3	[illegible]												
a	[illegible]	[illegible]					[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	
b	[illegible] 1.6 gm				[illegible]	[illegible]	[illegible]		[illegible]	1		[illegible]	18
	Canned												
538	[illegible] gm	[illegible]	[illegible]		[illegible]		[illegible]	[illegible]	[illegible]	11	[illegible]	1	
539	Dried solids												
a	1 [illegible]	[illegible]	1		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
b	3 [illegible] (14[illegible] gm)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	11	[illegible]	[illegible]	[illegible]
541	Potato chips 10 medium [illegible] or [illegible] (3 [illegible] 0 gm)	[illegible]	13	[illegible]	[illegible]	([illegible])	( )	([illegible])	(10)	([illegible])	([illegible])	( )	2
543	Pretzels 5 small sticks (5 gm)	18	4	2	[illegible]	1	[illegible]	0	(0)	Trace	Trace	Trace	(0)

Note [illegible] Asterisk indicates that values are calculated from a recipe [illegible] parentheses indicate [illegible] value

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
544	Prunes, dried, unsulfured												
	Uncooked												
a	4 large prunes, refuse, pits, 12% (40 50 per lb 1⅔ by 1 by ⅔ in, 40 gm)	94	8	2	24 8	19	30	1 4	660	0 03	0 06	0 6	1
b	4 medium prunes, refuse, pits, 15% (50 60 per lb, 1½ by 1 by ½ in, 32 gm)	73	6	2	19 2	15	23	1 1	510	03	04	5	1
c	4 small prunes, refuse, pits, 18% (70 80 per lb, 1⅓ by 1 by ½ in, 24 gm)	54	5	1	14 2	11	17	8	380	02	03	3	1
d	1 cup medium, refuse, pits, 15% (165 gm)	375	3 2	8	99 4	76	119	5 5	2,650	.14	23	2.4	4
545	*Cooked, no sugar added (med size), prunes and liquid, refuse, pits, 8%												
a	1 pound	523	4 6	1 3	137 9	104	167	7 5	3,720	13	33	3 3	4
b	1 cup, 16 18 prunes and ⅓ cup liquid (270 gm)	310	2 7	7	81 8	62	99	4 5	2,210	07	20	2 0	2
546	*Cooked, sugar added (med size), prunes and liquid, refuse, pits, 7%												
a	1 pound	695	4 2	8	182 3	93	143	6 3	3,160	13	.25	2 5	4
b	1 cup, 16 18 prunes and ⅓ cup liquid (315 gm)	483	2 9	6	126 6	64	100	4 4	2,200	09	.18	1 8	3
	See also Plums (Italian prunes), canned												
547	Prunes, canned, strained (infant food), 1 ounce	28	3	1	7 2	7	8	4	210	01	01	2	1
548	Prune juice, canned, 1 cup (240 gm)	170	1 0	0	46 3	(60)	(96)	(4 3)	--	(07)	(.19)	1 0	(2)
549	*Prune whip												
a	1 pound	674	12 7	1 4	168 4	118	191	8 2	3,910	17	49	3 3	9
b	1 cup (135 gm)	200	3 8	4	50 1	35	57	2 4	1,160	05	15	1 0	3

	Pudding, vanilla. See Blanc mange												
551	Pumpkin, canned, 1 cup (228 gm)	76	2.3	7	18.0	(46)	(82)	(1.6)	7,750	04	14	1.2	--
552	Radishes, raw, 4 small (40 gm), refuse, tops and rootlets, 51%	4	2	0	8	7	6	2	10	01	Trace	1	5
	Raisins												
553	Dried, unsulfured												
a	1 cup (160 gm)	429	3.7	8	113.9	125	206	5.3	80	24	.13	.8	Trace
b	1 tablespoon (10 gm)	26	2	0	7.1	8	13	3	Trace	02	01	Trace	Trace
554	*Cooked, sugar added, 1 cup (295 gm)	572	3.2	6	150.7	112	186	4.7	60	18	.12	6	Trace
	Raspberries												
555	Black, raw, 1 cup (134 gm)	100	2.0	2.1	21.0	54	50	1.2	0	03	(09)	(4)	(32)
	Red												
556	Raw, 1 cup (123 gm)	70	1.5	5	17.0	49	46	1.1	160	03	(08)	(4)	29
557	Frozen, 3 ounces	84	7	3	21.0	24	22	5	70	01	(03)	(2)	14
	Rhubarb												
558	Raw 1 cup diced (122 gm)	19	6	1	4.6	[1] 62	30	6	40	01	--	.1	11
559	*Cooked, sugar added												
a	1 pound	639	1.8	5	163.4	[1] 186	91	1.8	110	03	--	3	28
b	1 cup (272 gm)	383	1.1	3	97.9	[1] 112	54	1.1	70	02	--	2	17
	Canned in syrup. See Cooked												
	Rice												
560	Brown raw, 1 cup (208 gm)	748	15.6	3.5	161.6	81	630	4.2	(0)	66	10	9.6	(0)
	Converted												
561	Raw, 1 cup (187 gm)	677	14.2	6	148.5	45	254	1.5	(0)	38	06	7.2	(0)
562	*Cooked												
a	1 pound	525	10.9	5	115.3	36	195	1.4	(0)	25	04	4.9	(0)
b	1 cup (176 gm)	204	4.2	2	44.7	14	76	5	(0)	10	02	1.9	(0)
	White or milled												
563	Raw, 1 cup (191 gm)	692	14.5	6	151.7	46	260	1.5	(0)	13	05	3.1	(0)
564	*Cooked												
a	1 pound	542	11.4	5	118.9	36	204	1.4	(0)	06	04	1.9	(0)
b	1 cup (168 gm)	201	4.2	2	44.0	13	76[4]	5	(0)	02	01	.7	(0)
565	Precooked, dry, 1 cup (110 gm)	420	9.7	2	91.6	4	73	9	(0)	02	02	1	(0)

Note. Asterisk indicates that values are calculated from a recipe, parentheses indicate imputed value.
[1]Calcium may not be available because of presence of oxalic acid

TABLE 138—CONT'D

	FOOD, DESCRIPTION AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Rice products												
566	Flakes, 1 cup (30 gm)	118	1.8	.2	26.3	6	35	.5	(0)	.02	.03	.3	(0)
567	Flakes (added thiamine and niacin) 1 cup (30 gm)	118	1.8	.2	26.3	6	35	.5	(0)	.14	.03	1.6	(0)
568	Puffed, 1 cup (14 gm)	55	.8	.1	12.3	3	16	.3	(0)	.01	.01	.1	(0)
569	Puffed (added thiamine and niacin) 1 cup (14 gm)	55	.8	.1	12.3	3	16	.3	(0)	.06	.01	.8	(0)
	Rice, wild See Wild rice												
	Rolls												
570	Plain unenriched (pan rolls)												
a	1 roll (16 per lb, 28 gm)	86	2.5	1.5	15.4	15	27	.2	0	.02	.03	.3	(0)
b	1 roll (12 per lb, 38 gm)	118	3.4	2.1	20.9	21	36	.3	0	.02	.04	.4	(0)
c	1 roll (8 per lb, 57 gm)	176	5.1	3.1	31.4	31	55	.4	0	.03	.06	.6	(0)
571	Plain, enriched (pan rolls)												
a	1 roll (16 per lb, 28 gm)	86	2.5	1.5	15.4	15	27	[1].5	0	[1].07	[1].04	[1].6	(0)
b	1 roll (12 per lb, 38 gm)	118	3.4	2.1	20.9	21	36	[1].7	0	[1].09	[1].06	[1].8	(0)
c	1 roll (8 per lb, 57 gm)	176	5.1	3.1	31.4	31	55	[1]1.0	0	[1].14	[1].09	[1]1.3	(0)
	Sweet												
572	Unenriched												
a	1 package (6 rolls 330 gm)	1,065	28.0	25.7	177.5	208	343	2.0	0	.18	.44	3.3	(0)
b	1 roll (55 gm)	178	4.7	4.3	29.6	35	57	.3	0	.03	.07	.6	(0)
573	Enriched												
a	1 package (6 rolls 330 gm)	1,065	28.0	25.7	177.5	208	343	[1]5.9	0	[1].80	[1].51	[1]7.3	(0)
b	1 roll (55 gm)	178	4.7	4.3	29.6	35	57	[1]1.0	0	[1].13	[1].08	[1]1.2	(0)
575	Rutabagas cooked												
a	1 pound	145	3.6	.5	34.0	250	186	1.8	1,590	.23	.32	3.2	95
b	1 cup cubed or sliced (155 gm)	50	1.2	.2	11.6	85	64	.6	540	.08	.11	1.1	33
	Rye bread See Breads												
576	Rye flour, light, 1 cup, sifted (80 gm)	286	7.5	.8	62.3	18	148	.9	(0)	.12	.06	.5	(0)
580	Rye wafers or "Swedish health bread," 2 wafers (1⅞ by 3½ in 13 gm)	44	1.6	.2	9.8	6	52	.6	(0)	.04	.03	.2	(0)

	Salad dressings												
581	Commercial, plain (mayonnaise type)[2].												
a	1 cup (235 gm)	902	2 6	96 5	32 7	21	70	9	340	04	07	(0)	0
b	1 tablespoon (15 gm)	58	2	5 5	2 1	1	4	1	20	Trace	Trace	(0)	0
582	French												
a	1 cup (240 gm)	945	1 4	85 2	48 7	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
b	*1 tablespoon (15 gm)*	59	1	5 3	3 0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
583	*Home cooked, boiled												
a	1 cup (270 gm)	446	12 2	27 0	40 5	243	275	1 9	1,350	16	46	7	Trace
b	1 tablespoon (17 gm)	28	8	1 7	2 6	15	17	1	80	01	03	Trace	Trace
584	Mayonnaise[2]												
a	1 cup (205 gm)	1 451	3 1	159 9	6 2	39	123	2 0	430	07	07	(0)	0
b	1 tablespoon (13 gm)	92	2	10 1	4	2	8	1	30	Trace	Trace	(0)	0
	Salad oil See Oils salad, or cooking												
	Salmon												
	Cooked, Pacific broiled or baked												
586	1 steak (4 by 3 by ½ in, 120 gm)	204	33 6	6 7	2	--	500	1 4	--	12	33	9 8	--
	Canned, solids and liquid (including bones)												
587	Chinook or King, 3 ounces	173	16 8	11 2	0	[3] 131	246	8	200	02	.12	6 2	(0)
588	Chum, 3 ounces	118	18 3	4 4	0	[3] 212	299	6	50	02	13	6 0	(0)
589	Coho or silver, 3 ounces	140	17 9	7 1	0	[3] 197	216	8	70	02	.15	6 3	(0)
590	Pink or humpback, 3 ounces	122	17 4	5 3	0	[3] 159	243	7	60	03	16	6 8	(0)
591	Sockeye or red, 3 ounces	147	17 2	8 2	0	[3] 220	293	1 0	200	03	14	6 2	(0)
	Sardines												
	Atlantic type, canned in oil												
592	*Solids and liquid, 3 ounces*	288	17 9	23 0	.9	301	369	3 0	--	(01)	(.12)	(3 3)	(0)
593	Drained solids, 3 ounces	182	21 9	9 4	1 0	328	498	2 3	190	01	15	4 1	(0)

Note Asterisk indicates that values are calculated from a recipe, parentheses indicate imputed value.

[1]Iron, thiamine, riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity *of breads proposed* by the Federal Security Agency and published in the Federal Register, August 3, 1943

[2]Minerals and vitamins are calculated from a recipe.

[3]If bones are discarded, calcium content would be much lower Bones equal about 2% of total contents of can

TABLE 138—CONT'D

No.	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Sardines—Cont'd												
	Pilchards, Pacific type, canned solids and liquid												
594	Natural pack 3 ounces	171	15.1	11.5	.6	(324)	(143)	(3.5)	(20)	(.01)	(.26)	(6.3)	(0)
595	Tomato sauce, 3 ounces	184	15.1	12.6	1.4	324	143	3.5	20	.01	.23	4.5	(0)
	Sauerkraut, canned												
596	Solids and liquid, 1 cup (235 gm)	39	2.6	.5	8.0	85	42	(1.2)	80	.08	.15	.3	38
597	Drained solids												
a	1 pound	99	6.4	1.4	20.0	163	92	(2.3)	190	.15	.29	.5	74
b	1 cup (150 gm)	32	2.1	.4	6.6	54	27	(.8)	60	.05	.10	.2	24
	Sausage												
598	Bologna												
a	1 pound (1 by 2¾ in diam)	1,005	67.2	72.2	16.3	(41)	(508	10.0	(0)	.80	.85	12.2	0
b	1 piece (1 by 1½ in diam, 211 gm)	467	31.2	33.5	7.6	(19)	(236)	4.6	(0)	.37	.40	5.7	0
600	Frankfurter, cooked												
a	1 pound	1,131	64	91	9	27	222	5.4	(0)	.72	.83	11.3	0
b	1 frankfurter (51 gm)	124	7	10	1	3	25	.6	(0)	.08	.09	1.3	0
601	Liver, liverwurst, 2 ounces	150	9.5	11.7	.9	5	135	3.1	3,260	.10	.63	2.6	(0)
602	Pork, links or bulk, raw, 4 ounces	510	12.2	50.8	0	7	113	1.8	(0)	.49	.19	2.6	0
603	Pork, bulk, canned, 4 ounces	340	17.5	29.4	0	10	188	2.6	(0)	.23	.27	3.4	0
604	Vienna sausage, canned, 4 ounces	244	17.9	18.6	0	10	193	2.7	(0)	.11	.14	3.5	0
605	Scallops, raw, edible muscle, 4 ounces	89	16.8	.1	3.9	29	236	2.0	0	.05	.11	1.6	--
606	Shad or American shad, raw, 4 ounces E P	191	21.2	11.1	0	--	295	.6	--	(.17)	.27	9.6	--
607	*Sherbet[1]												
a	1 pint (386 gm)	475	5.8	.2	115.8	193	154	.1	0	.07	.29	.2	(0)
b	½ cup (96 gm)	118	1.4	.0	28.8	48	38	0	0	.02	.07	.0	(0)

608	*Shortbread (2 squares, 1¾ by 1¾ in 16 gm)	81	1.1	3.0	10.3	2	9	1	0	.01	Trace	1	(0)
	Shrimp canned												
609	Dry pack or drained solids of wet pack, 3 ounces	108	22.8	1.2	-	98	224	[illegible]	50	.01	.03	[illegible]	(0)
610	Wet pack solids and liquid 3 ounces	76	15.9	.8	3	50	[illegible]	1.7	50	.01	.03	1.2	(0)
611	Syrup table blends (chiefly corn syrup)												
a	1 cup (328 gm)	939	(0)	(0)	(242.7)	151	52	13.4	0	0	.03	3	(0)
b	1 tablespoon (20 gm)	57	(0)	(0)	(14.8)	[illegible]	3	.8	0	0	Trace	Trace	(0)
	Soups canned[2]												
	Bean												
612	Condensed 11 ounces	481	21	12.8	73.6	234	[illegible]	[illegible]		.25	.25	2.2	--
613	Ready to serve 1 cup (250 gm)	191	8.5	5.0	[illegible]	[illegible]	102	2.8	-	.10	.10	[illegible]	--
	Beef												
614	Condensed 11 ounces	248	15.0	8.4	[illegible]	37	[illegible]	9		--	-		--
615	Ready to serve 1 cup (250 gm)	100	6.0	3.5	11.0	15	62	5	--	-		--	--
	Bouillon broth and consomme												
616	Condensed 11 ounces	26	(6)		(0)	6	59	2.8	0	0	.12	1.6	0
617	Ready to serve 1 cup (240 gm)	9	(2)		(0)	2	24	1.0	0	0	.05	[illegible]	0
	Chicken												
618	Condensed 11 ounces	187	8.4	5.9	24.6	47	47	9	-	.06	.34	3.7	
619	Ready to serve 1 cup (250 gm)	75	3.5	2.5	9.5	20	20	5	-	.02	.12	1.5	-
620	Strained infant food), 1 ounce	17	9	7	1.7	11	13	1	70	Trace	.03	1	Trace
	Clam chowder												
621	Condensed 11 ounces	210	10.9	5.9	30.2	84	187	8.7	-	--	--		--
622	Ready to serve 1 cup (255 gm)	86	4.6	2.3	12.5	3	76	3.0	-	--	--	-	--

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1] Based on 6.8 pounds to the gallon *factory packed*

[2] All ready to serve soups are calculated from equal weights of the condensed soup and water except cream soup which was based on equal weights of the condensed soup and milk

TABLE 138—CONT'D

No.	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Soups, canned—Cont'd												
	Cream soup (asparagus, celery, or mushroom)												
623	Condensed, 11 ounces	279	6.9	16.2	29.6	162	140	9	500	12	53	3	3
624	Ready to serve, 1 cup (255 gm)	201	7.1	11.7	18.4	217	176	5	200	05	20	1	(0)
625	Liver soup, strained (infant food), 1 ounce	16	1.2	3	2.0	5	18	5	1,340	02	12	5	1
	Noodle rice or barley												
626	Condensed, 11 ounces	291	15.3	10.9	32.4	206	215	6	60	06	12	1.7	0
627	Ready to serve, 1 cup (250 gm)	117	6.0	4.5	13.0	82	85	2	30	02	05	7	0
	Pea												
628	Condensed, 11 ounces	357	16.2	5.0	63.6	81	249	3.7	(1,120)	41	19	3.1	9
629	Ready to serve, 1 cup (245 gm)	141	6.4	2.0	25.0	32	98	1.5	(440)	17	07	1.2	5
	Tomato												
630	Condensed, 11 ounces	230	5.6	5.6	45.5	65	97	2.2	(3,120)	06	25	1.1	22
631	Ready to serve, 1 cup (245 gm)	90	2.2	2.2	17.9	24	39	1.0	(1,230)	02	10	7	10
	Vegetable												
632	Condensed, 11 ounces	203	10.3	4.4	35.9	81	125	1.9	--	12	19	2.8	19
633	Ready to serve, 1 cup (250 gm)	82	4.2	1.8	14.5	32	50	8	--	05	08	1.0	8
634	Strained (infant food), 1 ounce	12	7	1	2.6	7	11	3	700	02	02	1	Trace
635	Vegetable and lamb soup, strained (infant food), 1 ounce	14	7	3	2.2	6	10	2	740	01	01	3	Trace
	Soups, dehydrated												
636	Navy bean, 1 ounce[1]	92	5.0	3	17.8	38	120	2.6	0	12	05	6	Trace
637	Pea, 1 ounce[2]	93	5.8	3	17.3	19	103	1.5	60	16	05	9	Trace
638	Soybeans whole, mature, dried, 1 cup (210 gm)	695	73.3	38.0	73.1	477	1,231	16.8	230	2.25	[illegible]	[illegible]	Trace

639	Soybean curd, 1 cake (2½ by 2¾ by 1 in., 120 gm.)	85	8.4	4.9	3.6	120	114	1.8	--	.07	.06	.4	(0)
	Soybean flour, flakes, grits												
640	Low fat, 1 cup soy flour, stirred, (101 gm.)	230	45.1	1.1	³38.1	248	620	13.1	70	1.11	.35	2.9	(0)
641	Medium fat												
a	1 cup soy flour, stirred (88 gm.)	232	37.4	5.7	³32.7	215	537	11.4	100	.72	.30	2.3	(0)
b	1 cup soy grits (138 gm.)	365	58.6	9.0	³51.3	337	842	17.9	170	1.12	.46	3.6	(0)
642	Full fat, 1 cup (soy flour, stirred, 72 gm.)	250	25.8	14.8	³21.5	140	398	8.7	100	.76	.20	1.6	(0)
643	Soybean milk (without added calcium and vitamins), 4 ounces	38	3.9	1.7	2.4	24	53	.8	--	.10	.05	.3	(0)
644	Soybean sprouts, raw, 1 cup (107 gm.)	49	6.6	1.5	5.7	51	72	1.1	100	.24	.21	.9	14
	Spaghetti												
	Unenriched												
645	Dry, 1 cup (2 in. pieces, 94 gm.)	354	12.0	1.3	71.9	21	155	1.4	(0)	.09	.06	1.9	(0)
646	*Cooked												
a	1 pound	678	23.2	2.7	137.1	41	295	2.7	(0)	.08	.08	2.2	(0)
b	1 cup (146 gm.)	218	7.4	.9	44.1	13	95	.9	(0)	.03	.02	.7	(0)
	Enriched												
647	Dry, 1 cup (2 in. pieces, 94 gm.)	354	12.0	1.3	71.9	21	155	⁴2.7	(0)	⁴.83	⁴.35	⁴5.6	(0)
648	Cooked												
a	1 pound	678	23.2	2.7	137.1	41	295	5.0	(0)	.79	.47	6.4	(0)
b	1 cup (146 gm.)	218	7.4	.9	44.1	13	95	1.6	(0)	.25	.15	2.1	(0)
	Spinach												
649	Raw, 4 ounces E.P.	22	2.6	.3	3.6	⁵92	62	3.4	10,680	.13	.23	.7	67

Note: Asterisk indicates that values are calculated from a recipe; parentheses indicate imputed value.

[1] Navy bean meal with farinaceous flour up to 15%.

[2] Pea meal with farinaceous flour up to 15%.

[3] Approximately 40% of this total amount of carbohydrate calculated by difference is sugar, starch and dextrin. The remaining portion is made up of materials thought to be utilized only poorly if at all by the body.

[4] Iron, thiamine, riboflavin and niacin are based on the minimum level of enrichment specified in the standards of identity promulgated under the [illegible] Drug and Cosmetic Act.

[5] Calcium may not be available because of presence of oxalic acid.

TABLE 138—CONT'D

	FOOD DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Spinach—Cont'd												
650	Cooked												
a	1 pound	115	14 1	2 7	16 3	[1] 563	150	9 1	53,480	36	91	2 7	136
b	1 cup (180 gm)	46	5 6	1 1	6 5	[1] 223	59	3 6	21,200	14	36	1 1	54
	Canned												
651	Solids and liquid, 1 cup (232 gm)	45	5 3	9	7 0	[1] 209	77	3 7	15,750	04	23	8	34
652	Drained solids												
a	1 pound	115	14 1	2 7	16 3	[1] 563	150	9 1	34,650	10	54	1 8	65
b	1 cup (180 gm)	46	5 6	1 1	6 5	[1] 223	59	3 6	13,740	04	21	7	26
653	Strained (infant food), 1 ounce	4	5	1	7	[1] 22	11	4	1,190	01	03	.1	2
656	Squash summer, cooked, diced												
a	1 pound	74	2 7	5	17 7	68	68	1 8	1,180	18	32	2 7	50
b	1 cup (210 gm)	34	1 3	2	8 2	32	32	8	550	08	15	1 3	23
	Squash winter												
	Cooked												
659	Baked mashed												
a	1 pound	215	8 6	1 8	50 0	109	159	3 6	28,100	23	68	2 7	31
b	1 cup (205 gm)	97	3 9	8	22 6	49	72	1 6	12,690	10	31	1 2	14
660	Boiled, mashed												
a	1 pound	171	6 8	1 4	40 0	86	127	2 7	22,470	18	45	1 8	23
b	1 cup (228 gm)	86	3 4	7	20 1	43	64	1 4	11,290	09	23	9	11
661	Canned, strained (infant food), 1 ounce	8	3	1	1 9	9	5	1	560	01	02	(1)	1
662	Starch, pure (including arrowroot, corn etc)												
a	1 cup (128 gm)	464	6	3	111 4	(0)	(0)	(0)	(0	(0)	(0)	(0)	(0)
b	1 tablespoon (8 gm)	29	0	0	7 0	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
	Strawberries												
663	Raw capped 1 cup (149 gm)	54	1 2	7	12 4	42	40	1 2	90	04	10	4	89
664	Frozen 3 ounces	90	5	3	22 6	19	19	5	30	02	04	2	35

	Sugars												
665	Granulated cane or beet												
a	1 cup (200 gm)	770	(0)	(0)	199 0			-	(0)	(0)	(0)	(0)	(0)
b	1 tablespoon (12 gm)	48	(0)	(0)	12 4		-		(0)	(0)	(0)	(0)	(0)
c	1 teaspoon (4 gm)	16	(0)	(0)	4 2			-	(0)	(0)	(0)	(0)	(0)
d	1 piece, lump sugar (1⅛ by ⅝ by ¼ in, 7 gm)	27	(0)	0	7 0				(0)	(0)	(0)	(0)	(0)
666	Powdered												
a	1 cup sugar (stirred before measuring 128 gm)	493	(0)	(0)	127 4				(0)	(0)	(0)	(0)	(0)
b	1 tablespoon (8 gm)	31	(0)	(0)	8 0				(0)	(0)	(0)	(0)	(0)
667	Brown												
a	1 cup firm packed (220 gm)	813	(0)	(0)	210 1	[2] 167	[2] 81	5 7	(0)	(0)	(0)	(0)	(0)
b	1 tablespoon (14 gm)	51	(0)	(0)	13 1	[2] 10	[2] 5	4	(0)	(0)	(0)	(0)	(0)
671	Maple 1 piece (1¾ by 1¼ by ½ in 30 gm)	104			(27)						--		--
	Sweet potatoes												
	Cooked												
673	Baked												
a	1 pound	611	10 0	4 1	156 2	168	272	4 1	[3]43 160	45	29	3 5	105
b	1 sweet potato peeled (5 by 2 in 120 gm)	183	2 6	1 1	41 3	44	72	1 1	[3]11 410	12	08	9	28
674	Boiled												
a	1 pound	560	8 2	3 2	126 7	136	222	3 2	[3]34 960	39	24	2 9	90
b	1 sweet potato peeled (5 by 2½ in 205 gm)	252	3 7	1 4	57 2	62	100	1 4	[3]15 780	18	11	1 3	41
675	Candied												
a	1 pound	813	6 8	16 3	164 3	163	204	4 1	[3]28 380	18	18	2 2	41
b	1 small sweet potato (3½ by 2¼ in 175 gm)	314	2 6	6 3	63 4	63	79	1 6	[3]10 940	07	07	9	16
676	Canned vacuum or solid pack 1 cup (218 gm)	233	4 4	2	54 5	54	89	1 7	19 300	12	09	1 1	31
	Swordfish												
679	Cooked, broiled												
	1 steak (3 by 3 by ½ in 125 gm)	223	34 2	8 5	0	25	314	1 4	2 880	06	07	12 9	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value
[1]Calcium may not be available because of presence of oxalic acid
[2]Calcium and phosphorus are based on dark brown sugar values would be lower for light brown sugar
[3]If very pale varieties only were used the vitamin A value would be very much lower

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL.	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
680	Tangerines (including other Mandarin type oranges), 1 medium tangerine ($2\frac{1}{2}$ in diam, 114 gm)	35	6	2	8 8	(27)	(19)	(3)	(340)	06	(02)	(2)	25
	Tangerine juice, unsweetened												
681	Fresh, 1 cup (246 gm)	95	2 2	7	22 6	47	39	(5)	(1,040)	17	(06)	6	75
682	Canned, 1 cup (246 gm)	95	2 2	7	22 6	47	39	5	(1,040)	(15)	(06)	(6)	(64)
683	Tapioca dry 1 cup, granulated quick cooking, stirred (152 gm)	547	9	3	131 3	18	18	(1 5)	(0)	(0)	(0)	(0)	(0)
	Tomatoes												
684	Raw												
a	1 medium E P (2 by 2½ in, 150 gm)	30	1 5	4	6 0	16	40	9	1,640	08	06	8	35
b	1 small E P (1¾ by 2¼ in, 110 gm)	22	1 1	3	4 4	12	30	7	1,210	06	05	6	26
685	Canned or cooked, 1 cup (242 gm)	46	2 4	5	9 4	(27)	(65)	(1 5)	2,540	14	08	1 7	40
686	Tomato juice, canned, 1 cup (242 gm)	50	2 4	5	10 4	(17)	(36)	(1 0)	2,540	12	07	1 8	38
687	Tomato catsup												
a	1 cup (273 gm)	268	5 5	1 1	66 9	33	49	2 2	(5,130)	25	19	6 1	31
b	1 tablespoon (17 gm)	17	3	1	4 2	2	3	1	(320)	02	01	4	2
689	Tomato puree, canned, 1 cup (249 gm)	90	4 5	1 2	17 9	(27)	(92)	(2 7)	4,680	22	17	4 5	69
	Tomato soup See Soups, canned, tomato												
690	Tongue, beef, medium fat, raw, 4 ounces	235	18 6	17	5	10	212	3 2	(0)	14	33	5 7	(0)
691	Tortillas, 1 tortilla (5 in diam, 20 gm)	50	1 2	(6)	9 7	22	37	4	[1] 40	04	01	2	--

	Tuna fish canned												
692	Solids and liquid 3 ounces	247	20 2	17 8	0	6	250	1 0	(180)	(04)	(08)	(11)	(0)
693	Drained solids, 3 ounces	169	24 7	7 0	0	(7)	(209)	1 2	70	04	10	10 1	(0)
694	Turkey, medium fat, raw, 4 ounces E P	304	22 8	22 9	0	[illegible]	303	4 3	Trace	10	16	9 1	(0)
	Turnips												
695	Raw, 1 cup diced (134 gm)	43	1 5	3	9 5	54	46	7	Trace	07	09	6	38
696	Cooked												
a	1 pound	122	3 6	9	27 2	182	154	2	Trace	18	27	1 8	82
b	1 cup diced (155 gm)	42	1 2	3	9 3	62	53	8	Trace	06	09	6	28
	Turnip greens												
	Cooked												
698	Boiled in small or moderate amount of water until tender												
a	1 pound	135	13 2	1 8	24 5	1 176	227	10 [illegible]	48,120	27	1 86	3 2	272
b	1 cup (145 gm)	43	4 2	6	7 8	376	72	3 5	15 370	09	59	1 0	87
699	Boiled in large amount of water long time												
a	1 pound	135	13 2	1 8	24 5	1 17[illegible]	227	10 9	48 120	23	1 63	2	204
b	1 cup (145 gm)	43	4 2	6	7 8	376	72	3 5	15 370	07	52	[illegible]	65
700	*Canned, solids and liquid*, 1 cup (232 gm)	41	3 5	[illegible]	7 4	232	70	3 7	10 210	03	21	1 [illegible]	45
	Veal, cooked												
705	Cutlet (wholesale round)												
a	1 pound without bone	993	127	50	0	54	1,171	15 9	(0)	[2] 37	[2] 1 26	[2] 27 5	0
b	3 ounces without bone	184	24	9	0	10	219	3 0	(0)	[2] 07	[2] 24	[2] 5 2	0
707	Shoulder roast (wholesale chuck)												
a	1 pound with bone	762	94	40	0	40	867	12 1	(0)	44	1 05	2[illegible] 5	0
b	1 pound without bone	1 029	127	54	0	54	1,171	16 3	(0)	60	1 42	33 8	0
c	3 ounces without bone	193	24	10	0	10	219	3 1	(0)	11	27	6 7	0

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1]Vitamin A value of tortillas made from yellow corn tortillas made from white corn have no vitamin A value

[2]Data assume cut to be prepared by braising or pot roasting Use of proportionate quantity of drippings would add approximately 50% more thiamine and niacin and 25% more riboflavin

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Veal, cooked—Cont'd												
709	Stew meat												
a	1 pound without bone	1,344	114	93	0	50	563	13.6	(0)	[1] 23	[1]1.09	[1]21.1	0
b	3 ounces without bone	252	21	18	0	9	105	2.6	(0)	[1] 04	[1] 20	[1]3.9	0
710	Veal, canned, strained (infant food), 1 ounce	24	4.5	5	0	4	48	5	(0)	01	09	1.6	0
711	Vegetables, mixed, strained, canned (infant food), 1 ounce	8	5	0	2.0	9	10	3	2	01	01	1	--
	Vienna sausage See Sausage												
712	Vinegar												
a	1 cup (240 gm)	29	0	--	(12.0)	17	24	1.2	--	--	--	--	--
b	1 tablespoon (15 gm)	2	0	--	(.8)	1	2	1	--	--	--	--	--
	*Waffles, baked with												
713	Unenriched flour												
a	1 pound	1,304	42.2	48.1	171.6	872	926	4.5	1,630	29	82	1.6	(0)
b	1 waffle (4½ by 5⅝ by ½ in, 75 gm)	216	7.0	8.0	28.4	144	153	8	270	05	14	3	(0)
714	Enriched flour												
a	1 pound	1,304	42.2	48.1	171.6	872	926	8.2	1,630	93	1.22	6.0	(0)
b	1 waffle (4½ by 5⅝ by ½ in, 75 gm)	216	7.0	8.0	28.4	144	153	1.4	270	14	20	1.0	(0)
715	Walnuts, Persian or English												
a	1 cup halves (100 gm)	654	15.0	64.4	15.6	83	380	2.1	30	48	13	1.2	3
b	1 tablespoon chopped (8 gm)	49	1.1	4.8	1.2	6	28	2	Trace	04	01	.1	Trace
	Water cress See Cress, water												
716	Watermelons, refuse, rind and seeds, 54												
a	Wedge (4 by 8 in, 1/16 melon 10 by 10 in, 925 gm)	120	2.1	9	29.4	30	51	9	2,530	20	22	.7	26
b	½ slice (¾ by 10 in, 345 gm)	45	8	3	11.0	11	19	3	950	08	08	3	10

	Wheat flours												
722	Whole (from hard wheats), 1 cup, stirred (120 gm)	400	16.0	2.4	83.2	41	446	4.0	(0)	46	14	5.2	(0)
723	80% extraction (from hard wheats), 1 cup sifted (110 gm)	365	13.2	1.4	81.5	20	210	1.4	(0)	29	08	2.3	(0)
	Self rising												
726	Unenriched, 1 cup sifted (110 gm)	385	10.1	1.1	81.2	291	532	1.1	(0)	08	05	1.3	(0)
727	Enriched, 1 cup sifted (110 gm)	385	10.1	1.1	81.2	[3] 299	532	[3] 3.2	(0)	[3] 48	[3] 29	[3] 3.8	(0)
	Patent												
	All purpose or family flour												
728	Unenriched, 1 cup sifted (110 gm)	401	11.6	1.1	83.7	18	96	9	(0)	07	05	1.0	(0)
729	Enriched, 1 cup sifted (110 gm)	401	11.6	1.1	83.7	18	96	[4] 3.2	(0)	[4] 48	[4] 29	[4] 3.8	(0)
	Bread flour												
730	Unenriched 1 cup sifted (112 gm)	408	13.2	1.2	83.7	18	106	1.0	(0)	09	06	1.1	(0)
731	Enriched, 1 cup sifted (112 gm)	408	13.2	1.2	83.7	18	106	[4] 3.2	(0)	[4] 49	[4] 29	[4] 3.9	(0)
732	Cake or pastry flour, 1 cup sifted (100 gm)	364	7.5	8	79.4	17	73	5	(0)	03	03	7	(0)
	Wheat products												
	Bran, breakfast cereals See Bran												
733	Flakes, 1 cup (35 gm)	125	3.8	6	28.1	16	115	1.0	(0)	03	06	1.7	(0)
734	Flakes (added iron, thiamine, and niacin) 1 cup (35 gm)	125	3.8	6	28.1	16	115	1.5	(0)	20	06	2.2	(0)
735	Germ, 1 cup stirred (68 gm)	246	17.1	6.8	33.7	57	745	5.5	(0)	1.39	54	3.1	(0)
736	Puffed, 1 cup (12 gm)	43	1.3	2	9.6	6	39	4	(0)	01	02	6	(0)
737	Puffed (added iron, thiamine, and niacin) 1 cup (12 gm)	43	1.3	2	9.6	6	39	5	(0)	07	02	8	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value

[1] Use of proportionate quantity of liquid would double amount of thiamine and niacin and add one third *more riboflavin*

[2] Vitamin A value ranges from 270 to 1 510 I U per ounce

[3] Iron thiamine riboflavin and niacin are based on the *minimum level of enrichment* specified in the standards of identity promulgated under the Food, Drug and Cosmetic Act Calcium is based on the level usually found in self-rising flour, which is in excess of the minimum (500 mg per pound) required See introductory paragraphs

[4] Iron thiamine riboflavin and niacin are based on the minimum *level of enrichment specified in the standards of identity* promulgated under the Food Drug and Cosmetic Act

TABLE 138—CONT'D

	FOOD, DESCRIPTION, AND APPROXIMATE MEASURE	FOOD ENERGY CAL	PROTEIN GM	FAT GM	TOTAL CARBOHYDRATE GM	CALCIUM MG	PHOSPHORUS MG	IRON MG	VITAMIN A VALUE I U	THIAMINE MG	RIBOFLAVIN MG	NIACIN MG	ASCORBIC ACID MG
	Wheat products—Cont'd												
	Bran												
739	*Rolled, cooked												
a	1 pound	341	10 0	1 8	76 7	36	345	3 2	(0)	33	12	4 1	(0)
b	1 cup (236 gm)	177	5 2	9	39 9	19	179	1 7	(0)	17	06	2 1	(0)
	Shredded												
740	Plain												
a	1 large biscuit (4 by 2¼ in, 1 oz)	102	2 9	7	22 7	13	102	1 0	(0)	06	03	1 3	(0)
b	1 small biscuit 2½ by 2 in, 22 gm)	79	2 2	6	17 6	10	79	8	(0)	05	03	1 0	(0)
c	1 round biscuit (24 gm)	86	2 4	6	19 2	11	86	8	(0)	05	03	1 1	(0)
741	With added malt and sugar 1 cup bite size biscuits or 1 cup shreds (60 gm)	213	5 3	7	49 7	30	202	2 5	(0	1 11	09	2 7	(0)
743	*Whole meal, cooked												
a	1 pound	327	12 3	1 4	71 7	41	377	3 2	(0)	47	15	4 2	(0)
b	1 cup (243 gm)	175	6 6	7	38 4	22	202	1 7	(0)	25	08	2 3	(0)
745	*Whole meal (added wheat germ, iron and thiamine), cooked												
a	1 pound	248	9 5	1 4	53 6	36	295	22 2	(0)	1 00	12	3 9	(0)
b	1 cup (243 gm)	133	5 1	7	28 7	19	158	11 9	(0)	53	06	2 1	(0)
	Wheat and malted barley cereal See Breakfast foods, mixed cereals												
748	*White sauce, medium												
a	1 pound	736	18 2	56 8	40 0	522	431	5	2 310	16	70	5	2
b	1 cup (265 gm)	429	10 6	33 1	23 3	305	252	3	1,350	09	41	3	1
749	Wild rice, parched, raw, 1 cup (163 gm)	576	23 0	1 1	122 7	31	553	--	(0)	73	1 03	10 0	(0)
	Yeast												
750	Compressed, baker's, 1 ounce	24	(3 0)	1	3 7	7	172	1 4	(0)	13	59	8 0	(0)
751	Dried, brewer's, 1 tablespoon (8 gm)	22	(3 0)	1	3 0	8	151	1 5	(0)	78	44	2 0	(0)

Note Asterisk indicates that values are calculated from a recipe parentheses indicate imputed value
For brands that are oven toasted thiamine will be 0 03 mg

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